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NURSING MANUAL FOR NURSES NURSING ORDERLIES

NCAN C. L. FITZWILLIAMS

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HENRY FROWDE AND HODDER & STOUGHTON
AT THE OXFORD PRESS WAREHOUSE, FALCON SQUARE,
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A NURSING MANUAL FOR NURSES AND NURSING ORDERLIES

BY

DUNCAN C. L. FITZWILLIAMS

M.D., CH.M., F.R.C.S.

SURGEON-IN-CHARGE OF OUT-PATIENTS AND LECTURER IN CLINICAL SURGERY, ST. MARY'S HOSPITAL; SENIOR ASSISTANT SURGEON, PADDINGTON GREEN CHILDREN'S HOSPITAL; CAPT. 1ST CITY OF LONDON FIELD AMBULANCE ETC.

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PREFACE

At the present time no excuse is needed for issuing a book which, it is hoped, will increase medical knowledge among nurses, orderlies, and Red Cross workers, which will promote the efficiency of their nursing and which will thereby help to relieve suffering.

This Manual is based upon the instructions which it has been my duty to impart to the nurses of St. Mary's Hospital, to the nurses of Paddington Green Children's Hospital, and to non-commissioned officers and men of the First City of London Field Ambulance. An extensive experience in examining candidates for Red Cross Certificates had prompted me to arrange the book so that the common diseases are associated with the anatomical and physiological description of the organs concerned; this stimulates the interest of the student and helps better than any other arrangement the association of his ideas.

This book is primarily intended for the use of nurses, and I have endeavoured to include all the essentials which a nurse, a nursing orderly or a Red Cross worker should know. A great deal of first aid in Red Cross work will fall to the share of male

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nurses and orderlies, and for that reason the First Aid in the Field has been fully dealt with, and will, I hope, prove of value to members of the Territorial Units of the R.A.M.C.

I am indebted to the Publishers for the use of illustrations from the following books: Cunningham's *Textbook of Anatomy*, Despard's *Textbook of Massage*, Groves and Brickdale's *Textbook for Nurses*, Ker's *Infectious Diseases*, Waring's *Manual of Operative Surgery* and *The Red Cross Notebook;* also to Messrs. Weiss & Co. for supplying electros of instruments, etc.

D. C. L. F.

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CHAPTER I

PRELIMINARIES

HARDLY anything in medicine is more remarkable than the rapid development of the department of nursing. A little while ago nurses in the modern sense did not exist even in hospitals, now the amount of care expended on the training and education of nurses is enormous and still tends to increase.

The public expects very much more from nurses now than it did, while the doctor has learned to rely more and more upon her observation, judgment, skill and good sense.

A nurse's training now ranges over anatomy, physiology, pathology or the knowledge of disease, the treatment of disease, medical and surgical knowledge, hygiene and also all that is meant by the word nursing as applied to the comfort and care of the sick.

In addition to all this her training teaches her discipline, exactness, neatness and observation, in fact everything that goes to the making up of character.

Health, strength and endurance are not given to every one equally, and it is highly important that they should be conserved as much as possible. A nurse's training, it should be recognised, is a great tax upon her. Many nurses break down under

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the strain, others, while not actually breaking down, lose all keenness and interest in their work. Close attention should therefore be paid to the rules and regulations which are drawn up for the guidance of the probationer.

Punctuality is of great importance, not only on account of its own merits, but as evidence of exactness and trustworthiness.

Obedience and faithfulness are inborn in some, but can only be acquired in others. Always remember the loyalty you owe to the doctor in charge of the case; the dependence he often places upon your judgment and observation must never be betrayed; the nurse sees far more of the patient than does the doctor, and is therefore a much better judge of some things.

Gentleness and refinement, sympathy and tact, patience and perseverance are all qualities to be cultivated, for without them no nurse will be a success. The "doctor nurse" is an abomination, while the highly trained, unsympathetic machine is useless.

Dress, etc.—A nurse must always be neat and clean in her dress. Her uniform should be correct, her nursing clothes should be washable. Jingling chatelaines must be avoided, but a pocket-case containing pins, tape measure, spatula, scissors, will always be useful; to these instruments can be added a thermometer and a probe. A good watch is important, some form of stop watch with a large second hand is best.

Footgear is most important, as so much standing induces flat-foot in those who are not strong; this may not be recognised for some time and serious

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damage may be done which will take months to rectify; it is commonly found among probationers before they are hardened to the work. High heels, thin soles, very soft shoes, are all to be avoided; the shoe should be stout and give good support to the arch of the foot without being noisy.

Observing and Reporting.—Observation is a faculty which can be educated to a very high degree, and no opportunity should be omitted of practising it; but what exactly you should be on the look out for in each case can only be learned by experience and training. Deducing results from what you observe is a totally different thing, and one which is much more difficult and requires a great deal of experience.

Reporting is the way in which observations are recorded. The memory should never be trusted, facts should always be written down at the time, and the hour should be noted opposite. The record should be made on the chart or in a book provided for the purpose. Practice alone will enable you to distinguish what is from what is not important. The report should contain everything since the doctor's last visit. The chief points are—

1. The temperature, which is taken twice daily or four hourly, sometimes even oftener over short periods.
2. Pulse and respirations; these should be taken at the same time as the temperature.
3. Excretions, including motions, urine and the times they were passed.
4. Sleep, its amount and nature, quiet, disturbed, delirium, etc.

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5. Nourishment; this will of necessity be noted at different places, but at the end of the day the amounts should be added up, so much milk, broth, etc., so that the quantity and nature of the food can be seen at a glance.
6. Special symptoms should be noted, such as vomiting, pain, rigors, etc.; these are mentioned in dealing with the diseases.
7. Special treatment, such as application of fomentations, the giving of enema, the passing of a catheter, all should be noted. In some hysterical cases a special watch has to be kept upon the patient without the patient becoming aware of the fact. When anything unusual is observed a note should be made and the doctor's attention should be directed to it.

Self-education should be pursued steadily by the nurse, it is the little learning which is the dangerous thing, and the more she knows and understands the better. Medical and surgical ideas are constantly changing and a *nurse's training is never finished.*

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CHAPTER II

THE SKELETON AND LOCOMOTOR SYSTEM

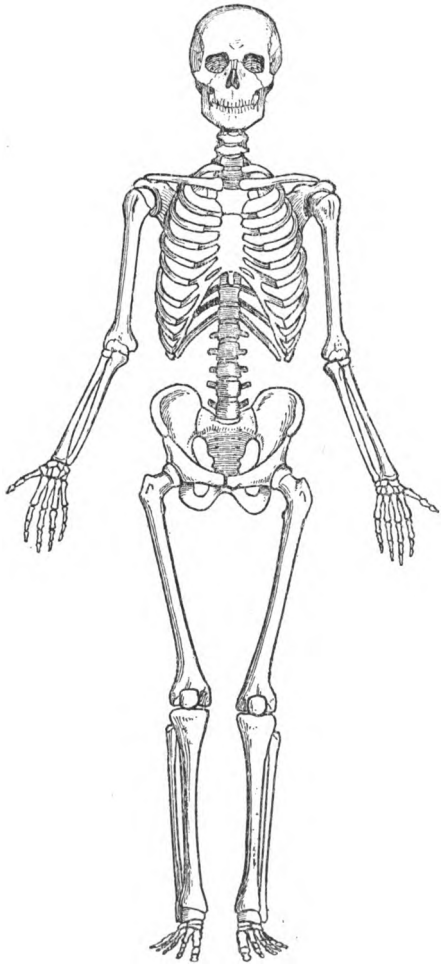

FIG. 1.

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The Skeleton or Bony Framework of the Body

General Considerations.—The skeleton is the bony framework of the body, about which all the softer and less resistant parts are arranged, and by which they are all supported. It is composed of upwards of two hundred bones of various shapes and sizes—long, short, flat and irregular. The bones are living tissues in which a large amount of mineral salts, phosphates and carbonates of lime is deposited; this deposit supplies the hardness required to support the weight of the body.

When the skeleton is examined we notice that it consists of a head portion, a trunk, and four limbs. The upper part of the trunk is the thorax, which is formed into a kind of cage surrounded by the ribs; below this there is a portion unprotected by bone at the front and sides, and below this again is the pelvis, which is a basin formed of very strong bones. The reason for this arrangement becomes more apparent as knowledge of anatomy increases, for we will find that all the more important or vital organs are situated in regions where they are best protected from injury. In the thorax or chest are situated the heart and lungs. The lower part of the trunk is the abdomen or belly. The thorax and the abdomen are separated from each other by a thin muscle called the diaphragm, which is attached by its edge to the lower margin of the thorax, while its central portion forms a dome which reaches about as high as the nipple of the breast. The division, therefore, between the thorax and abdomen does not take place at the waist, or even at the lower

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part of the ribs as many suppose, but quite half-way up the thoracic cage. In the abdomen are the liver, spleen, kidneys, pancreas, all solid organs, also the stomach and intestines which are hollow organs

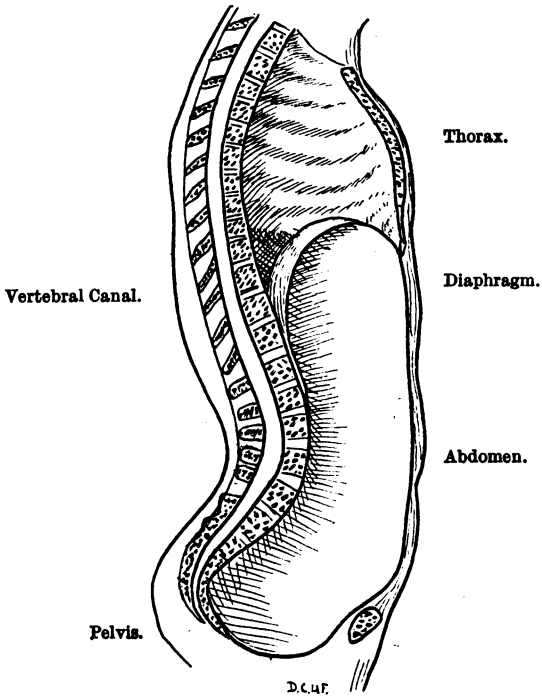

FIG. 2.—Diagram showing main divisions of the body cavity.

and freely movable. As the solid organs cannot move they are liable to injury from blows and kicks; to prevent this they are all lodged in the upper part of the abdomen, under cover of the lower ribs just below the diaphragm.

The hollow organs can move about under the

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impulse of a blow and therefore are not so vulnerable, they are therefore situated more in the exposed portion of the trunk. In the lower part of the abdomen, protected by the bones of the pelvis, we find other important organs which are only slightly mobile, such as the bladder, the ovaries and the uterus or womb, so that the bones of the trunk are arranged to give most protection to those organs which most require it.

The head is designed somewhat in the same way, as the bones are arranged to protect the delicate brain from injuries, while such organs as the eyes, the hearing part of the ear, and the tongue are either situated in recesses or protected by strong prominences of bone.

The limbs are joined to the trunk by means of two girdles, the pectoral girdle consisting of the clavicle and scapula for the upper limb, and the pelvic girdle comprising the three parts of the hip bone for the lower limb. As the lower limb has to sustain the whole weight of the head, trunk and two upper limbs, its bones are much more massive than those of the upper limb.

The Bones of the Skull

The skull is formed of twenty-two bones and is divided into two parts, the cranium or brain case, and the face. The former is composed of eight bones and the latter of fourteen.

The Cranium.—The bones which form this are the frontal, two parietal, two temporal, one occipital, one sphenoid, one ethmoid.

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A. *The Frontal* bone forms the front of the skull, the forehead and bounds the upper part of the orbits or recesses for the eyes.

B. *The Parietal* bones form the upper part of the sides and top of the head.

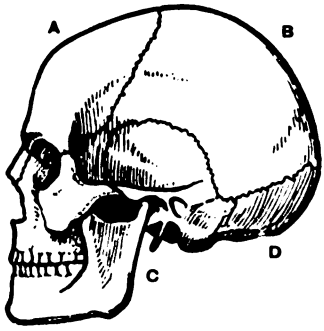

FIG. 3.

C. *The Temporal* bones form the lower part of the sides of the cranium, and in them the organ of hearing is lodged.

D. *The Occipital* bone forms the back part of the skull and floor of the cranium. In its lower part is a large round hole, the foramen magnum, through which the spinal medulla passes to the vertebral canal. On each side of the foramen is a smooth rounded process which rests on the upper surface of the topmost vertebra.

The Sphenoid is a very irregularly shaped bone and forms the middle part of the floor of the cranium.

The Ethmoid forms the front part of the floor of the skull at the root of the nose.

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Both these last two bones are closely associated with the bones of the face.

If the interior of the cranium be examined the vault and sides are seen to be smooth, but the floor is irregular and has various ledges upon which the brain rests. The floor, too, is pierced in many places by apertures which give exit and entrance to the various nerves and blood-vessels.

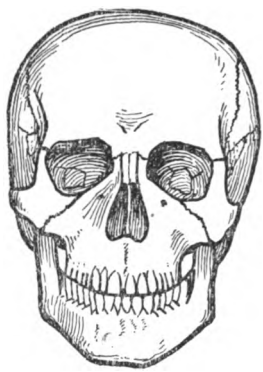

FIG. 4.

The Face is composed of fourteen bones—the two nasal, two zygomatics, two maxillæ, mandible, two lacrimals, two palate bones, two inferior conchæ and the vomer.

The Nasal bones form the hard bridge of the nose, to the front of which are attached the nasal cartilages. These together shut in the space containing the organ of smell.

The Zygomatic bones form the prominent parts of the cheek and bound the orbits below.

The Maxilla or upper jaw bears the upper teeth on each side, and by forming the front part of the roof of the mouth (the palate) and floor of the nose serves to separate these two cavities.

The Mandible forms the lower jaw and supports the lower set of teeth. It is the only movable bone of the skull. If the fingers are placed immediately in front of the ears the joints

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can be felt working on opening and shutting the mouth.

The remainder of the bones of the face do not require special mention, they are all small bones which go to complete the bony walls of the nose, orbits, and mouth, they do not show on the face.

With the exception of the mandible all the other bones are fitted tightly to one another with dentate edges, the joints being termed sutures as they appear sewn together.

In the newly born child the bones do not meet over the vault of the cranium, the deficiency being filled by membrane only, so that a soft spot can easily be felt called the fontanelle.

The edges of the bones can also be recognised as they have not yet locked together. The fontanelle should close soon after the child is a year old; in certain diseases affecting bones such as rickets, the closure is delayed.

The Bones of the Trunk

The bones of the trunk comprise those of the spinal column, the chest or thorax, and the pelvis.

The Vertebral Column or back-bone consists of thirty-three bones, called vertebræ, which are placed one above the other. The upper twenty-four vertebræ are movable and are arranged as follows—

Five cervical vertebræ forming the neck.

Twelve dorsal vertebræ bearing the ribs.

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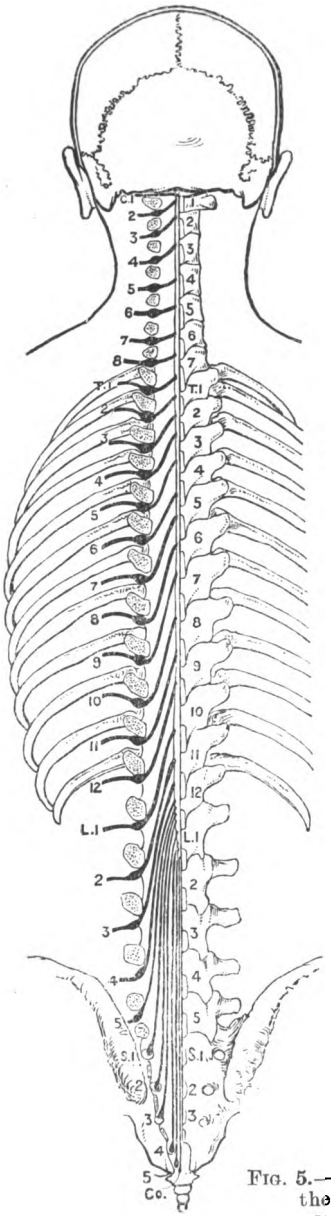

FIG. 5.—Diagrammatic Representation of the Origin of the Spinal Nerves.

Five lumbar vertebræ forming the loins.

The next five are the sacral vertebræ all fused together to form the sacrum and united to the pelvic bones.

Then four small coccygeal vertebræ which represent the remnants of a tail.

All the **vertebræ** are fashioned on much the same plan, and the following parts should be noted.

The Body or solid rounded portion is united to the body of the next vertebræ above and below it by means of an intervertebral disc. This is a cushion of tough cartilage which allows a certain amount of movement and also prevents jarring. Behind the body is a ring from which spring three processes, a medium one, the spinous process, projects back-

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wards, and two lateral ones called transverse processes.

The spinous process is the portion of bone which can be felt in the furrow down the middle of the back. To these processes are attached the various strong muscles which move the back.

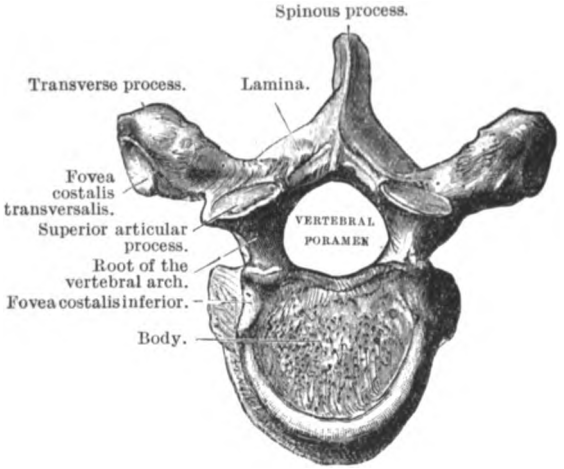

FIG. 6.—Fifth Thoracic Vertebra.

The lateral processes in the dorsal region help to support the ribs.

Strong ligaments bind the intervertebral discs to the bodies of the vertebræ, in addition, very strong ligaments pass down the front and back of the bodies of the vertebræ and between the adjacent processes. By these means a very strong column is formed, rigid enough for the support of the trunk and sufficiently supple to allow movement between the individual bones.

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When each vertebra is in position the ring portions placed one above another form a long canal in which is lodged the delicate spinal medulla, which is thus protected from injury.

The Sacrum is large and strong and forms the base upon which the vertebral column rests. Through it the weight of the body is transmitted to the hip or innominate bone on each side and through them to the lower limbs. The sacrum fits in between the hip bones like the keystone of an arch. The three bones together form the pelvis. To the tip of the sacrum the coccyx is attached.

The Bones of the Thorax

The Thorax or chest is formed by the dorsal portion of the vertebral column behind, the sternum or breast bone in front, and the ribs on each side.

The Ribs, twelve on each side, are curved elastic bones which pass from the vertebral column behind round the chest wall to end in front by becoming tipped with a tough piece of cartilage. The upper seven ribs are joined by this cartilage to the sides of the sternum or breast bone and are called true ribs. Of the remaining five ribs, called the false ribs, three run towards the lower part of the sternum, their cartilages joining the cartilages of those above them; the last two remain free and are called floating ribs. Ribs are easily broken, but the upper ones are short and protected by the shoulder, while the lower ones are so mobile they escape, so that those

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in the middle of the series, the fifth to ninth, are the ones most frequently damaged.

The Sternum or breast bone is the broad flat bone which runs down the middle of the front of the chest. It is joined on each side by the clavicle and the seven true ribs.

The Bones of the Upper Limb

The Clavicle or collar bone is a curved bone about five inches long which reaches from the upper part of the sternum to the scapula or shoulder blade. It is the bone which gives the squareness to a man's shoulder as compared with that of a horse, where none is present. The bone very commonly is fractured from falls upon the hand.

The Scapula or shoulder blade is a flat triangular bone situated at the side and back of the thorax. Its outlines can easily be felt under the skin. It has an upper, lower and outer angle. At the outer angle is a smooth depression, the glenoid cavity, which forms the shoulder joint for the head of the humerus.

The Humerus or arm bone is what is called a long bone, and all long bones are said to have a shaft and two extremities or ends. The upper end or head of the humerus is large, and has a smooth joint surface for the glenoid cavity and bony prominences for the insertion of muscles. The lower end is of irregular shape to join with the upper ends of the radius and ulna. The shaft of the bone is smooth and rounded in the upper part, but rather triangular below.

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The Radius or outer of the two bones of the forearm has a rounded button-like upper end which fits on to the humerus, and a broad lower end which supports the wrist bones. This lower end is often fractured by falls upon the hand.

The Ulna is the inner of the two forearm bones and has a large process at its upper end called the olecranon which fits round the back of the lower end of the humerus and makes the joint very strong. The lower end of the bone is small and rounded, and takes little part in the formation of the wrist joint.

The Carpus or wrist is formed of eight small bones arranged in two rows of four each, the joint between the first row and the radius is the wrist joint.

The Metacarpal bones form the palm of the hand and are five in number, they rest on to the second row of carpal bones. The metacarpal of the thumb is more mobile than the others.

The Phalanges are the small bones of the digits, each finger has three and the thumb two. The last phalanx has a rough surface which carries the nail.

The Bones of the Lower Limb

The Pelvic girdle or pelvis is formed by the sacrum and coccyx behind, and the two hip bones at the sides and the front.

The Hip bone is a large irregular bone. It is really formed by the fusion of three bones, the ilium, the ischium, and the pubis.

The Ilium is the broad, flat, expanded upper part which unites behind with the sacrum. *The Ischium* is the part below and behind, and the

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rough area called the tuberosity supports the weight when sitting. *The Pubis* is the smallest of the three parts, and is situated in front, where it is united by ligaments to its fellow of the opposite side at the symphysis of the pubis. The ilium, ischium and pubis all join each

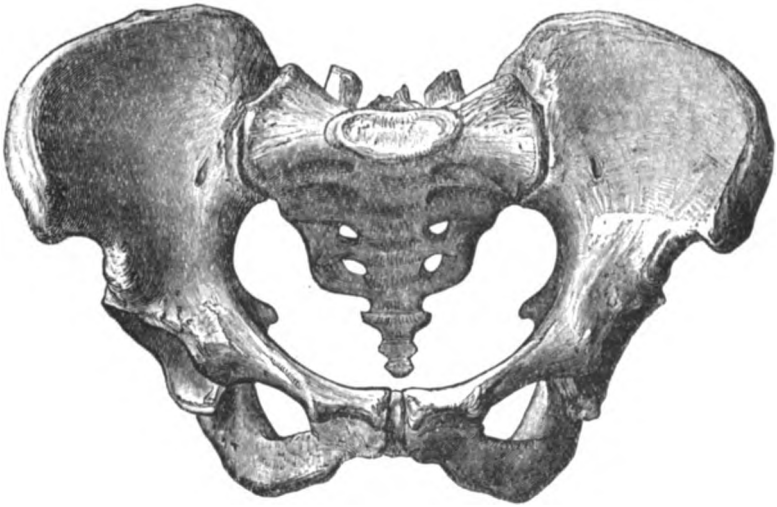

FIG. 7.—The Female Pelvis seen from the front.

other at the acetabulum or cup-shaped hollow on the outer side of the bone which receives the head of the femur to form the hip joint.

The Femur or thigh bone is the largest and strongest bone in the body. Its upper end has a rounded head which is received into the socket of the hip joint or acetabulum, near it are the two trochanters, great and small, for the insertion of powerful muscles. The lower end is expanded into two condyles which rest upon the upper part of the tibia to form the

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knee joint. Down the back of the shaft is a rough ridge, the linea aspera, to which muscles are attached.

The Patella or knee-cap is the small movable bone in front of the knee, it is triangular with the point downwards. The back is smooth and works on a smooth surface on the front of the two condyles of the femur to help the action of the muscles which straighten the knee. The bone is situated in the tendon which becomes attached to the tubercle of the tibia.

The Tibia or shin bone is the inner and much the larger and stronger of the two bones of the leg. Its upper end is expanded into two tuberosities, inner and outer, which support the two condyles of the femur at the knee joint. The shaft of the bone is three-sided and the sharp edge can be felt under the skin. Near the upper part of the front of the bone is the tuberosity into which is inserted the tendon of the muscles which straighten the knee. The lower end of the tibia makes the prominence on the inner side of the ankle which is known as the internal malleolus, and with the lower end of the fibula forms a box-like socket which unites with the tarsus at the ankle joint. On account of its exposed position the shaft of the bone is often fractured by kicks and blows.

The Fibula is the outer and weaker of the two bones of the leg. The upper end is attached to the tibia but takes no part in the formation of the knee joint. Its lower end forms the outer prominence or malleolus of the ankle. The shaft is so thin that it is often broken about three inches above the ankle.

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The Bones of the Foot are arranged on the same principle as the bones of the hand. The tarsus is composed of seven bones, the talus, calcaneus, navicular, three cuneiform bones and the cuboid. Of these the *Talus* fits in between the two malleoli of the leg bones to form the ankle joint, and rests on top of the bone of the heel.

The Calcaneus is the bone which forms the prominence of the heel and takes a large part of the weight.

The remainder of the tarsal bones are smaller and support the metatarsals, of which there are five. They are larger and stronger than the metacarpals, as they have to support the weight of the body.

The Phalanges are arranged in series, three to each toe, with the exception of the big toe, which, like the thumb, has only two. They are smaller than the corresponding bones of the hand, as the toes are not so important and useful as the fingers.

The weight of the body is divided between the heel and the ball of the toes, which correspond to the rounded heads of the metatarsal bones. The intervening arch supplies spring to step and prevents jarring and jolting.

The Growth of Bones.—Bones are not always the hard resistant structures they are in the adult. They are developed from one of two sources, membrane or cartilage, and at birth the bones are still largely composed of these materials.

The bones developed from membrane are the flat bones which form the vault of the skull, and there are intervals of membrane still present at birth which can be felt where no bone has yet

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formed. The largest of these intervals is felt on the fore part of the head and is called the anterior fontanelle. This fontanelle does not close till after the first year of life. In backward or rickety children the closure may be delayed for two or three years.

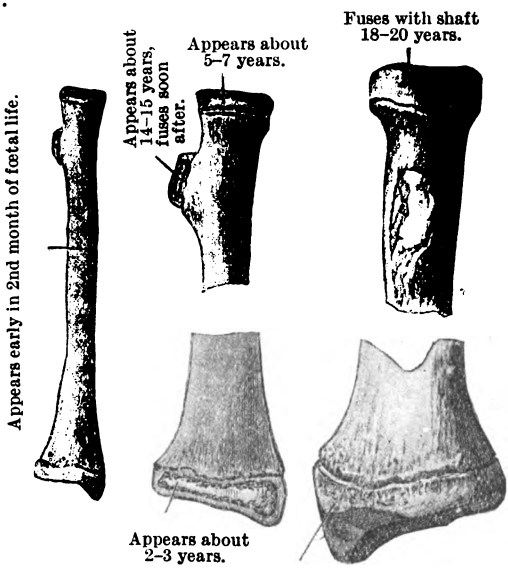
Fuses with shaft 18–20 years.
Appears about 5–7 years.
Appears about 14–15 years, fuses soon after.
Appears early in 2nd month of fetal life.
Appears about 2–3 years.
Unites with shaft 20–25 years.
At birth.
About 12 years.
About 16 years.

FIG. 8.—The Ossification of the Radius.

All the bones of the limbs and trunk are developed from cartilage and are largely composed of this material at birth, so that they are soft and easily bend or break if roughly handled. An ordinary long bone such as the humerus begins to ossify in three main areas, there is one centre for the shaft or middle of the bone and one for each of the two ends. The shaft is called the diaphysis and the two ends

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are the epiphyses. There is always one centre of ossification in each epiphysis, but often there are several, and these several centres all join and fuse together as growth continues until there comes a time when the shaft has all become bone and the two ends are all bone, but there is between each end and the shaft a small plate of cartilage called the epiphyseal cartilage or the epiphyseal line. This is all that remains of the original cartilage with the exception of the cartilage-covered joint surfaces. This plate goes on growing, but as fast as it grows the edges become transformed into bone and in this way the bone grows in length. This change goes on constantly till the age of about twenty-one, when the cartilage all become bone and no more growth can take place. The bone all this while grows in thickness by new bone being formed under the periosteum, which is the tough fibrous membrane which surrounds the bone. Fractures in children are often not true breaks but really are separations of the epiphysis from the shaft, as the soft cartilage has given way; this injury is called a diastasis. As a result the cartilage may ossify and the growth stop, causing a deformity.

Locomotor System

Joints or Articulations are the means by which bones are joined together. There are many varieties of joints. There are joints between the bones of the head, called sutures, which allow no movements between the bones. There are joints between the vertebræ, each one of which allows a very slight amount of movement, but as there are many joints the aggregate range becomes ample. And lastly there are joints which allow free move-

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ments such as those of the limbs. But even in the freely movable joints the movements which are allowed to each joint are sharply defined and none others can be carried out.

Examples.

1. In the joints between the phalanges of the fingers a hinge-like movement is allowed, flexion or bending and extension or straightening. This same movement and no other is allowed in the corresponding joints of the foot in the elbow and the knee.
2. In the joint between the metacarpal bone and the first phalanx a side to side movement is admitted in addition to flexion and extension. This side movement is called adduction when it is towards the middle line of the hand, abduction when it is away from this line. These four movements are allowed in the corresponding joints of the foot, in the wrist, and to a less extent in the ankle.
3. At the shoulder and the hip rotation can take place in addition to these other four movements, so that the limb can be rolled round.

Other examples could be quoted of movements allowed, but these suffice.

We must now examine the structure of a joint, it consists of the following—

1. The articular ends of the bones.
2. The ligaments.
3. The synovial membrane.
4. The inter-articular menisci.

1. *The Articular Ends of the Bone* usually have reciprocating surfaces, that is to say, one is

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convex and the other is concave and they fit one into the other. If the concavity is very marked then the joint is very strong, if, however, the concavity is only a shallow one the bones are more liable to slip off each other. As examples of the strong joint, the

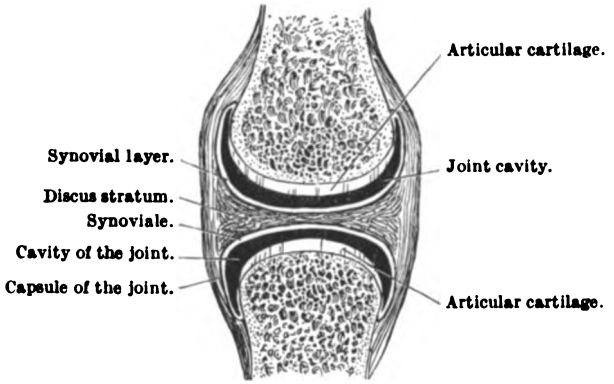

FIG. 9.—A joint.

hip and the elbow may be given, while those weak in this respect are the shoulder and the knee. The surfaces of bone are smooth and covered with cartilage, which is slightly elastic and so acts as a buffer; the surface being very smooth allows of easy movement.

2. *The Ligaments* are tough fibrous bands which are attached to the bones beyond the cartilaginous surfaces. The bands are of varying length and are very inelastic, so that they check the movement as soon as they become taut. As one becomes taut the opposite one becomes lax and vice versa.

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3. *The Synovial Membrane* is the membrane which lines the inner surfaces of the ligaments, and covers all the parts of the bones inside the joint except the cartilage. The membrane secretes an oily fluid, the synovial fluid, which lubricates the joint and makes it work smoothly.
4. *Inter-Articular Menisci* are present only in a

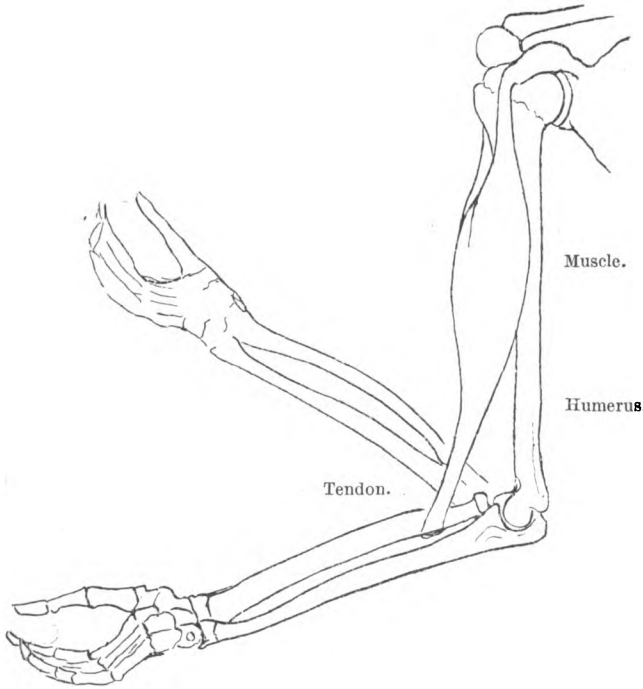

FIG. 10.—Bones of Arm showing Muscle Attachment.

few joints, usually in those in which the bones do not fit each other closely. As a rule they are arranged round the edge and serve to deepen the hollow in which the end of the

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opposite bone fits. There are two of these cartilages in the knee joint and occasionally they may become loose and cause trouble.

The Muscles are the means by which movement is carried out, no movement takes place without their aid. The muscles are attached to the bones by their two ends, by means of tough fibrous or tendinous tissue; some of these tendons are quite short, others are long and narrow and pass a long way down the limb before they are inserted into the bone. The tendons are quite passive and only serve to convey the pull of the muscles. The active part of the muscle is called its fleshy belly. This muscular part constitutes the meat of our diet. The fleshy belly is composed of muscular fibres arranged parallel to one another, these are collected and held together in bundles by a small amount of fibrous tissue. The bundles are attached to the tendons. Passing to each muscle is a nerve which breaks up in the muscle, giving off numberless branches to the different fibres. The nerve serves to convey to the muscle the impulse of the brain or will which causes it to contract. The muscle performs its function by contracting, that is to say, it becomes shorter and at the same time thicker, with the result that the tendons at the two ends, and therefore the bones to which they are attached, are approximated. For this to happen it is necessary for movement to take place at a joint.

The muscles are grouped together on the different aspects of the joints, and working together or in turn produce the movements required. As one set contracts the opposite set relaxes.

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CHAPTER III

THE NERVOUS SYSTEM AND THE SPINAL MEDULLA

Anatomy and Physiology

THE nervous system comprises the brain, spinal medulla and the nerves which connect these two with the different organs in the body. We need not discuss here the different sense organs.

Every movement of the body, whether voluntary or involuntary, is brought about by means of the nervous system. If we will to do anything we do it through the agency of the nervous tissues, which act as a medium between our abstract mind and our concrete muscles. The nervous system governs, regulates and controls all the other systems, sending out its messages and commands along the nerves, which act as telegraph wires connecting up all the distant areas with the central telegraph centre or control office.

The Meninges or Membranes of the brain and spinal medulla. These are three in number: an external tough dura mater; a second, middle in position and density, the arachnoid mater; and a third, a very delicate structure closely applied to the brain, called the pia mater. The dura is closely applied to the inner surface of the cranial bones, and conveys to them their blood-vessels, it also sends processes between the main divisions of the brain to steady them. The arachnoid is closely applied to the

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inner surface of the dura. The pia is closely adherent to the surface of the brain, into the convolutions and irregularities of which it dips, conveying the blood-vessels to its interior. There is a considerable space between the arachnoid and the pia, called the sub-arachnoid space, in which the cerebro-spinal fluid lies. The membranes serve to hold and steady the brain and spinal medulla in place, while the fluid acts as a water-bed warding off jolts and jars from the bony surfaces which surround them.

The Brain is the expanded upper portion of the

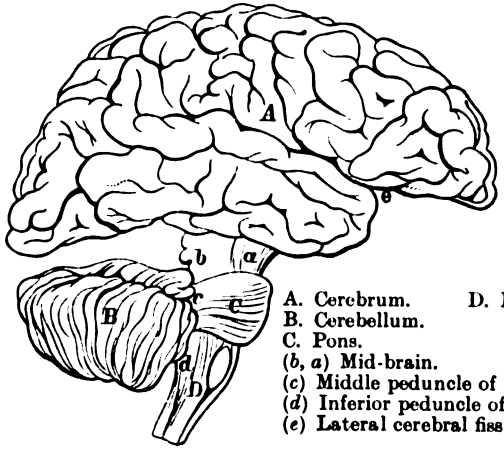

FIG. 11.—Brain.

cerebro-spinal axis, filling the cavity of the cranium. It is divided into several portions, the chief being—

1. The cerebrum or great brain.
2. The cerebellum or lesser brain.
3. The pons or the bridge.
4. The medulla oblongata, which is continuous with the spinal medulla.

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If a section is made through the brain we can see the arrangement of the white and grey nervous matter composing it. In the cerebrum and cerebellum we find the grey matter arranged on the outside, and thrown into many irregularities and convolutions to increase its extent. The white matter lies internally, though here and there, near the base of the brain, large masses of grey matter called basal ganglia are also seen.

In the Spinal Medulla the white matter is outside, while a central core of grey matter runs down internally. The grey matter is composed of nerve cells with long processes, which run to other parts of the brain and may leave the brain or cord as nerves. Innumerable bundles of these processes make up the white substance.

The Cerebrum forms the bulk of the brain and consists of halves or hemispheres, the right and the left, separated by a deep median fissure. The outer surface is composed of grey matter, which is thrown into folds or convolutions, each one being separated from its neighbour by a sulcus. The larger sulci are called fissures, they serve to map out the surfaces into lobes, called after the portion of the skull with which they lie in contact. The three great fissures are the lateral cerebral fissure, the fissure of Rolando, and the parieto-occipital fissure. The chief lobes being the frontal, parietal, occipital, and temporo-sphenoidal.

The cerebrum is the seat of sensation, intelligence and the will, each hemisphere presiding over the opposite half of the body, and though their appearance does not differ, the several portions or centres of the brain have different functions over which

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they preside. For instance, the motor centre which presides over the movements of muscles, is situated in the frontal lobe just in front of the fissure of Rolando, hence the name of the Rolandic or motor area.

The muscles of the different parts of the body are grouped together, from below upwards they are as follows: face, arm, trunk and lower limb; the body being represented upside down.

The perception of sight is in the occipital lobe, that of taste and smell in the temporo-sphenoidal lobe, a little way from the centre for the perception of sounds, which is in the same lobe, but only on the left side of the brain. The centre for speech is in the lower and back part of the frontal lobe, also only on the left side. The parietal lobe is believed to be concerned chiefly with the perception of other sensations.

The Cerebellum or lesser brain consists of two hemispheres deeply convoluted in a foliate or leaf-like manner. The hemispheres of the cerebellum preside over the co-ordination of the muscles of their own side of the body. Co-ordination is the regular working together of large groups of muscles so that each contracts just the required amount. This is most important, especially in actions which require careful balance, such as standing, walking, etc. By the cerebellum, too, we know the position of our own limbs without looking to see where they are placed. Muscular movement originates in the cerebrum, but is organised and arranged in the cerebellum. When the cerebellum is diseased or destroyed, the patient cannot walk without staggering about, while the trembling and jerking of the

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muscles prevents him carrying out his movements properly.

The Pons or bridge is the name given to the tract of white nerve fibres which pass from one cerebellar hemisphere to the other across the front of the medulla oblongata.

The Medulla Oblongata is the part of the brain which joins on to the spinal medulla. It is about an inch in length and broader above than below. It is composed chiefly of white nerve fibres passing between the brain and spinal medulla and vice versa, with a small amount of very important grey matter in its interior. If the cerebrum or cerebellum are removed from an animal death does not necessarily follow at once, but the functions of the medulla are such that instant death follows its destruction. It contains the centres which preside over the involuntary movements of the heart and respiration, the stoppage of which would extinguish life. All messages from the brain to the muscles of the trunk and limb, and all sensory messages passing in the reverse direction must pass through the medulla. A large number of the cerebral nerves leave from this part of the brain.

Cerebral Nerves.—From the under surface of the brain twelve pairs of cerebral nerves are given off; they are numbered one to twelve in the order they appear, starting from the front. Nerves are said to be sensory, motor or mixed. A sensory nerve carries sensory impressions to the brain and is called afferent. A motor nerve carries motor impulses from the brain to the muscles and is said to be efferent. Mixed nerves possess fibres of both sorts.

The first pair are the olfactory, or nerves of smell,

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and pass from the mucous membrane of the upper part of the nose to the brain.

The second pair are the optic nerves, or nerves of sight; they pass from the retina of the eyeball to the brain.

The third pair are motor, and called the oculo motor, which means movers of the eye, as they supply most of the eye muscles.

The fourth pair are motor, and supply one eye muscle each.

The fifth pair are large, mixed nerves; they divide into three large branches, from which the name trigeminal is derived. They carry sensation from the face and motor impulses to the muscles of the jaw.

The sixth pair are motor, and supply the muscles which turn the eyes outwards. The eyes are therefore supplied by three nerves, the third, fourth, and sixth.

The seventh pair are motor, and supply the muscles of facial expression, and so are called the facial nerves.

The eighth pair are the auditory nerves, the sensory nerves of the ear.

The ninth pair are mixed nerves, called the glosso-pharyngeal, as they are the sensory nerves of the tongue, and therefore the nerves of taste; they are also motor to the muscles of the pharynx.

The tenth pair are mixed nerves, sometimes called the pneumogastrics from the fact that they supply among other organs the lungs and stomach. They are better known as the vagi, as each vagus wanders to supply the viscera as far as the lower part of the abdomen.

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The eleventh pair are motor, called accessory; they supply the muscles in the neck.

The twelfth pair are motor to the muscles of the tongue, under which organ they run, hence the name hypoglossal.

The Spinal Medulla

The spinal medulla is a cylinder of nerve matter about 18″ long, contained in the vertebral canal of the vertebral column. It extends from the medulla above to the first lumbar vertebra below, and is about as thick as the little finger.

The three Membranes or Meninges of the brain are continued down round the spinal medulla as the spinal meninges. On making a cross section of the spinal medulla the following points become evident. The spinal medulla is divided into right and left halves by an anterior and a posterior fissure, the former of which is the better marked.

The white matter formed of nerve fibres is arranged round a central core of grey matter.

In each half of the spinal medulla the grey matter is arranged in an anterior and a posterior horn, of which the posterior is the narrower, the more pointed, and reaches to the surface of the medulla, while the anterior is short and broad, and does not reach the surface. In the centre of the grey matter is a central canal, too minute for the unaided eye to see.

The spinal nerves are given off in pairs, all the way down the spinal medulla, thirty-one pairs in all, each pair leaves the vertebral canal between two adjacent vertebræ.

Those in the upper part of the canal pass out transversely to their points of emergency, but lower

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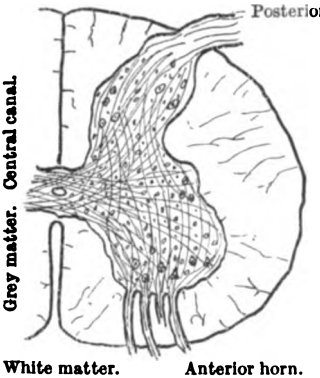
down the nerves have to pass down the canal some way before they escape, as the cord does not reach to the bottom of the canal. Below the level of the spinal medulla, therefore, the nerves are crowded together to form the corda equina or mare's tail.



Transverse section of spinal medulla magnified.

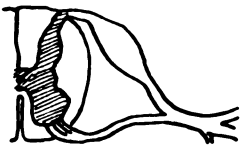


Diagram of the spinal medulla and spinal nerve, showing anterior and posterior nerve roots.

FIG. 12.

The spinal medulla has two enlargements where it is thicker than elsewhere, these are the cervical and the lumbar enlargements where the large nerves of upper and lower limbs leave the medulla.

The Functions of the Spinal Medulla.—The medulla is the great conductor of impulses up to and down from the brain. If our foot is pricked with a pin, we draw the foot away from the irritation with great rapidity. We can see the cause and effect, but the history of the action is as follows: The pin runs, let us say, into the left foot, the sensation travels up the spinal nerve to the spinal medulla, which it enters by the posterior nerve root. The

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sensation then passes up the nerve fibres, forming the white matter at the back of the spinal medulla to the medulla oblongata; here it crosses over to the opposite side and ascends to the grey matter of the right hemisphere of the cerebrum. The same nerve fibre does not travel the whole distance, but the impulse is passed on from one fibre to another. In the cerebrum a message is sent to the centre for the muscles of the leg, and an impulse is sent downwards to the medulla oblongata, here it crosses over to the left side of the spinal medulla, and, passing down the white matter in the front of the cord, ends in the cells of the anterior horn of grey matter. From here the impulse leaves the cord by the anterior nerve root and so goes to the muscles, which contract and draw up the foot.

Though this takes a long time to describe, the impulses travel at such a rate that the action seems almost instantaneous. The cord, besides being a great conductor of impulses, can perform what are called reflex actions, which can be carried on with little or no voluntary control from the brain. We have seen how impulses travel up and down from the brain in the ordinary way, but the sensory nerves give off branches in the cord at different levels, which pass into the posterior horn of grey matter, and so reach the motor cells in the anterior horn, and set up an impulse which will pass to the muscles. In this way the impulse may reach the anterior horn cells by a short cut, without conveying any impression to the brain. This constitutes a reflex act. Many voluntary movements, such as walking or running, can be performed in this way, while the brain is occupied with other matters. Hundreds of

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actions are performed daily by the spinal medulla without the brain being called into action. The act of breathing and the contractions of the heart are reflex actions.

If the spinal medulla is cut across, communication with the brain is thereby lost. No voluntary motor impulses will travel down beyond the point of section, and no sensory impulses will reach the brain from the nerves beyond—the muscles are paralysed and the skin is apparently insensitive. But though voluntary action has been destroyed, there still remain the short cuts mentioned above, which are the paths of reflex action, so that some actions can still be brought about. By these means the bowels will act and the bladder will empty itself, the patient being quite unaware of the fact.

The Spinal Nerves.—Each nerve arises by two roots, anterior and posterior. The anterior nerve roots are motor and arise in cells in the anterior horn of grey matter and pass outwards. The posterior nerve roots are sensory, and pass inwards at the point where the posterior horn of grey matter reaches the surface of the cord. On each posterior root is a swelling or ganglion which contains the cells from which the sensory fibres run in both directions into the spinal medulla and out to form the nerve. By the union of these two roots a mixed nerve is formed, which is capable of carrying centrally sensations derived from the periphery and of conveying to the muscles impulses from the brain and cord.

If a mixed nerve is divided, the muscles supplied beyond the cut are paralysed and the skin supplied becomes anæsthetic. If the distal portion of the

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cut nerve is stimulated, muscular contraction will take place for a few days after which time the nerve fibres will die, and if function is to be restored new fibres must grow down from the proximal cut end. If the proximal cut end is stimulated, a painful sensation will be felt in the part beyond the cut. This part of the nerve will not die, but will grow out and try to join up with the distal end.

If a mixed nerve, such as a nerve to the lower limb, be irritated anywhere in its course, it will carry the sensation of pain to the brain, which will refer the sensation to the terminals of the nerve in the skin of the foot or toes, and therefore the pain is felt as if in these areas. In this way a blow on the elbow catching the funny-bone, which is really a nerve, will set up a tingling feeling in the fingers. If the nerves in an amputation stump are irritated, the irritation will set up a sensation of pain in the fingers or toes, although they have been amputated.

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CHAPTER IV

DISEASES OF THE NERVOUS SYSTEM

Apoplexy.—An apoplectic fit, or a stroke, are terms very commonly used to denote a condition which causes injury to one side of the brain, resulting in *hemiplegia* or paralysis of one half of the body. It is usually due to the bursting of the blood-vessel inside the brain, the hæmorrhage causing destruction of the brain tissue round about.

Symptoms.—The patient is elderly but is usually in good health, when suddenly he feels pain in the head and falls to the ground. Often the attack comes on after some slight exertion or after a meal. The arm and leg on one side cannot be used, and the face may be drawn to one side. There is usually some loss of consciousness, but this is temporary in the slight cases, but in the severe forms all the symptoms of compression appear.

Management is that of compression, *q.v.* In all cases which do not prove rapidly fatal, the paralysis gradually becomes less though even in the slight cases some remainder is left. In the severer cases the limbs become stiff, contracted and difficult to move, or spastic as it is termed. If the arm or leg on the right side are affected there is usually some loss of speech also.

Paraplegia or spinal paralysis, may be the result of injury crushing and destroying the cord

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as in some cases of fracture of the spine, or it may be due to inflammation of the spinal cord, myelitis. Lastly it may be due to pressure upon the cord from tumours or disease as in tuberculous caries of the vertebræ.

Symptoms.—In injuries and acute inflammatory condition paralysis comes on suddenly, in other cases it develops slowly and the symptoms vary slightly with the level of the lesion. As a rule there is pain round the trunk at the level of the injury. There is loss of voluntary movement in the muscles below this level and the paralysed part is anæsthetic. Loss of control over the bladder and rectum is a marked and distressing feature as the bladder may become distended and overflow, or the urine may dribble away continuously, the bowels act unconsciously. Trophic changes take place in the insensitive skin and bed-sores develop with great rapidity at any spot where there is constant pressure. In the inflammatory cases there is a tendency for the inflammation to spread up and affect the vital centres, in the more chronic cases death usually comes on from infection through the urinary tract in spite of every care on the part of the nurse of the helpless patient.

Management. Bed-sores.—These cases are very difficult to nurse as bed-sores develop so easily and the sheets become constantly soiled and wet from excreta. *To prevent bed-sores* the patient should be placed at once upon a water-bed, failing this a ring air-cushion should be placed under the sacrum to relieve the pressure, and the position of the patient altered slightly from time to time. Ring pads should be made to fit under the heels, and the patient care-

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fully examined daily for areas of skin which are beginning to show red. The back should be well washed with soap and water and dried thoroughly with dusting powder, and gently rubbed to increase the circulation. Bathing the skin with spirits of wine before applying the powder helps to harden it. Perfect cleanliness, dryness, and constant care to change, and remove wrinkles from the draw sheet are essential if sores are to be prevented. Once the sore has become established it is very slow to heal.

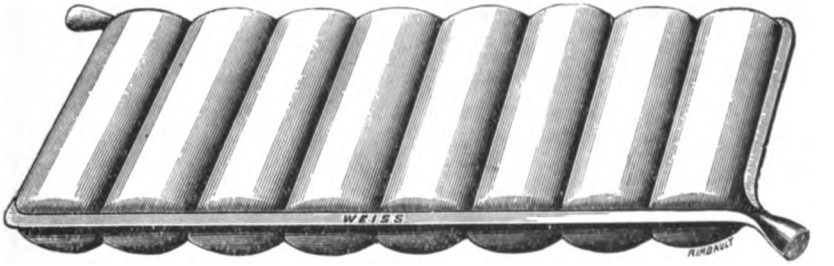

FIG. 13.—Water-bed.

All pressure should be removed from the part by cushion or ring pad. Ointment should be applied to the sore itself on a small piece of lint cut to the shape of the ulcer; ointment too may be smeared on the surrounding skin which is covered by another piece of lint, the lint being kept in position with strapping. The ordinary yellow or red mercurial ointments or white precipitate ointments are very suitable. It is a good plan to change the ointments now and then or to stop them altogether and apply lint dipped in some stimulating substance like red lotion.

A careful watch must be kept upon the urine to

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see that the bladder is not infected, especially is this the case if the catheter has to be used. Any shreds or ammoniacal smell in the urine should be reported at once. The temperature is often slightly above normal, but becomes irregular at once if sepsis occurs.

Changing Sheets.—With the helpless this has to be done without exposure or removing them from bed, as follows: The upper clothes with the exception of the sheet and one blanket are removed.

To Change the Upper Sheet.—The blanket is held while the upper sheet is drawn out so that the patient is now only covered with the blanket. The clean sheet is spread over the blanket and held in position while the blanket is drawn from under it in turn. The blankets and other covers can then be replaced.

To Change the Under Sheet.—The pillow is removed and the patient rolled gently on to his side, the soiled sheet is loosened along the side and folded to the middle of the bed close under the patient's back. The clean sheet similarly folded lengthways is placed against the soiled one, the unfolded portion being smoothed and tucked in along the side of the mattress. The patient is then rolled over to the opposite side and the soiled sheet removed, the folded part of the clean sheet is then drawn over, smoothed and tucked in. While the patient is rolled over, it is a good opportunity to examine the skin of the back, and to do anything that is needed in the way of washing and making applications to it, as the old sheet serves to catch any moisture and is afterwards removed.

The Draw Sheet.—This is a most important nursing

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accessory used to prevent the bed becoming damp or soiled. An ordinary sheet folded two or three times lengthways so that it is broad enough to reach from the lumbar region to the knees of the patient. It is laid across the bed and the extremity tucked in on one side, the main part of the sheet is then folded and tucked in flat under the mattress on the opposite side.

When soiled or damp a fresh portion is unfolded from under the mattress and drawn under the patient, who is gently raised for the moment. The soiled part is rolled up and pinned, but should not be tucked in under the mattress. In this way a fresh, dry portion of the sheet can be substituted for a damp one with very little disturbance. If the patient cannot be turned he should be raised slightly to draw the sheet over. The sheet can be changed in the same manner as an under sheet, or by pinning the new and the old sheet end to end, then, when the patient is lifted and the old sheet drawn on, the new one is brought into place.

Lifting and Moving Patients should always be carried out gently. A strong nurse can manage to lift a light patient single-handed, by placing one arm under the shoulders and the other under the knees, a second person is required to carry out instructions regarding the bed, etc. With heavy patients, however, two are required to lift. They should stand on opposite sides of the bed and join hands under the shoulders and knees of the patient, while a third person does what is necessary. Heavy patients are therefore seldom lifted, and are usually rolled over on to the side, the lower sheet or draw sheet may be used to hold them over. A patient

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may be able to help a great deal if there is a rope or pulley suspended from the ceiling which he can catch hold of.

Bed-pans are either made in enamelled iron or in earthenware. The commonest shapes are the round and the slipper; the former is suitable for males, the latter for females. The bed-pan should be warmed before use or else a piece of flannel interposed between it and the patient's body. The round pattern is slipped in from the side when the patient is raised slightly. The slipper is inserted from below, the patient bending his knees and so helping to raise himself. When removed the pan should be covered with a towel, taken away, emptied, and cleaned at once, unless it is desirable to keep the specimen to show the doctor. The pan should always be washed clean and rinsed in an antiseptic. It should always be quite dry when given to the patient as strong antiseptics might irritate the skin.

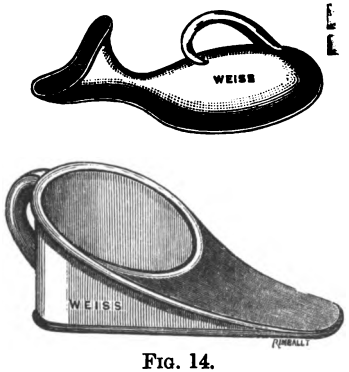

FIG. 14.

Paralysis.—This may be of many different forms besides the two we have already considered.

Infantile Paralysis is due to inflammation of the spinal medulla. It is usually seen before the child is six years old and is seldom met with after ten years. It most frequently comes on during the summer months, and the onset is marked by fever and

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vague pains; often there is diarrhœa. A few days later one or more of the limbs are noticed to be weak or paralysed, or it is found that the child is unable to stand. Parents usually attribute the condition to a supposed fall, or carelessness on the part of the nurse, who is blamed very unjustly.

Management.—The limbs should be rubbed and kneaded gently towards the body. Light splints should be applied to prevent the foot assuming a deformed position. Electricity is useful and tonics should be given. Considerable recovery takes place during the first three to six months, after that recovery is very slow. Recovery is rarely perfect, some permanent weakness usually being left.

Locomotor Ataxy is a disease which comes on as a rule after middle life, and is so named because the patient has great difficulty in walking about owing to his imperfect control over his legs. As long as the patient can see, he can get about fairly well, though he jerks his legs about in an irregular manner. But with the eyes closed or in the dark when he cannot see objects to balance by, he has great difficulty in standing, as his muscles no longer let him know what his limbs are doing. Often the disease is accompanied by severe shooting or lightning pains which pass down his legs. He may also have trouble with his bladder or rectum, and later his sight becomes defective. Deep ulcers may form on the feet if corns are neglected. In the later stages, when the patient is confined to bed, the same precautions must be taken as in paraplegic cases.

Neuritis, or the inflammation of nerves, causes pain along the nerve, and weakness and paralysis of the muscles supplied. Neuritis may be caused by

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blows or other injuries, by exposure to cold, or as the result of poisoning the system by the constant absorption of alcohol or lead. The toxines of certain diseases such as diphtheria may cause neuritis and paralysis.

The symptoms of a case of alcoholic neuritis are pains and tenderness of the limbs, easily elicited on squeezing the calf muscles. The limbs tremble violently on attempting to use them, and increase in weakness and loss both of power and sensation, so that eventually the patient is unable to walk. The whole nervous system is much upset in these cases, the appetite is impaired and the actions of the bowels disordered.

Management.—In the ordinary neuritis, time and ordinary care are needed, and with massage, electricity and tonics, recovery usually takes place.

In alcoholic cases, however, the nurse must have her wits about her. The patient, usually a middle-aged or elderly female, has to be watched with the greatest care to make quite sure that the supply of alcohol has really stopped. Such patients exercise extraordinary ingenuity in devising means whereby the supply can be continued without the knowledge of the nurse or doctor. If spirits cannot be obtained through the friends, servants, or from a secret store, methylated spirits or even scent may be drunk. These patients, too, are very difficult to manage on account of their mental instability.

They must be coaxed to take plenty of food, and care taken that they do not develop bed-sores if confined to bed. As soon as the pain passes off gentle massage is of great benefit.

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Epilepsy may run in families, and show itself at any time of life, but usually commences in youth. The fits may be brought on by mental excitement, or any stimulation such as alcohol or even cold or indigestion.

Epileptic fits may be of two kinds, in the mild form (petit mal) there is temporary mental obscurity —the person loses himself momentarily, but there are no convulsive movements and he rapidly recovers, though he may be a little dull for some time after.

In the severer form (grand mal) there are well-marked convulsive movements of the muscles and complete loss of consciousness. This form of epileptic fit is often preceded by an aura, or warning sensation, which tells the person that an attack is approaching. Suddenly the patient falls, perhaps with a slight cry. As the tonic part of the fit commences the muscles of the body and limbs are tightly contracted, the eyes turn upwards or to the side. The face is pale, but as the chest is rigid and no breathing takes place, the colour gradually becomes livid, the pupils are dilated, and sometimes the bladder and the rectum are emptied. The tonic then gives place to the clonic stage, in which the muscles work in a jerky manner, the face and head are twitched about and the limbs worked spasmodically, and the tongue protrudes between the working jaws. Froth appears at the lips, and this may be blood-stained if the tongue is bitten. Respiration starts again and the fit is at an end. The patient may remain senseless for a time and then pass into sleep, or may wake up and vomit, or a series of fits may follow each other in quick succes-

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sion. When once the disease has become established it usually lasts throughout life, lessening in frequency after middle age. When the attacks are frequent, severe mental deterioration is marked and imbecility may become established. The fits are rarely fatal, but there is danger of the patient hurting himself seriously, for as he falls his head may strike the fender, or he may fall into the fire or into a stream.

Management.—If there is an aura, the patient should place himself in a position of safety, lying down with clothes loosened. While the fit is in progress something should be put between the teeth so as to prevent the tongue being bitten. After the fit has passed off the patient should be kept quite quiet. No fluid or stimulants should be given during the fit. A regularly moderated life is essential and occupations involving dangerous surroundings, such as bathing, shooting and fishing, must be given up.

Chorea, or St. Vitus' Dance, is seen in children, usually girls with impaired health; it is often associated with rheumatism and rheumatic fever (which is also liable to affect the heart). The actual onset of the disease is sometimes determined by fright, mental excitement or overwork.

Symptoms consist in jerky movements of the muscles of the limbs and face. These movements vary in intensity and may only be seen momentarily at intervals of several minutes, but in the severer form they are constant so that the child cannot keep still. They may be unable to hold things or may hit themselves against objects; feeding is difficult, and even sleep may be interfered with. During sleep, however, all the movements cease.

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During excitement, or when under observation, the movements are exaggerated. Children who have had one attack seem more likely to get another. Recovery is usual in childhood though the disease may last a long time.

When adults develop chorea it is more serious, especially if it be a woman who is pregnant. Adults may become maniacal, and the attack may end fatally from want of sleep, insufficient nourishment and exhaustion, especially when the heart is affected.

Management.—The child should be isolated if possible, and treated by itself. She should be freed from all mental and physical strain, put to bed and not allowed to read. Good diet, tonics, and care of the general health, are often sufficient to bring about a cure. Massage is useful. The child should not be sent to school till recovery is complete. In severe cases injury must be guarded against, the nurse controlling the movements as far as possible, and removing from reach objects against which the child is likely to strike. Bed-sores must be guarded against, as they are very likely to form from the constant rubbing movements. The patient must be coaxed to take food, for exhaustion lessens any control the patient may still have.

Hysteria is a disorder in which the functions of the body are seriously interfered with. The idea that a patient who is suffering from hysteria has nothing the matter with him must be put out of mind at once, it is often a most serious condition. The term "hysterical" unfortunately is used by the laity to denote something which is of no importance, or malingering. It affects women far more

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often than men; when affecting the latter the term hypochondriasis is sometimes applied, even children are not uncommonly affected with it.

Symptoms.—These have the widest variation, as any organ or function may be affected. Usually the individual is of a highly nervous temperament, lacks self-control, and then for some reason or another is affected with symptoms which simulate real organic disease, such as gastric ulcer, epilepsy, severe vomiting, or some form of joint trouble. Others have fixed pain in certain parts, feel a lump in the throat and are unable to take food, unable to pass water, and believe they do not sleep. Others, again, complain of anæsthesia in a limb or part of the body or may lose the power of speech and are only able to whisper. It is extremely difficult to tell these symptoms from organic disease unless a very careful examination is made. Usually, however, the symptoms are exaggerated, or may vary in intensity from moment to moment, or do not quite fit the picture—for instance, in hysterical fits though the patient may fall she never hurts herself and never bites her tongue; again, the great tenderness complained of over a region vanishes if the attention of the patient is distracted.

There is often some underlying cause to be made out, such as a depressed state of health, worry and overwork, or close association with a person who has been ill with the very disease from which they themselves appear to suffer. The bowels are constipated and there is great pain at the menstrual periods. As a rule, too, they are surrounded by very sympathetic relations and friends, whose anxious attentions only make matters worse.

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Management.—As soon as possible the patient should be separated from the friends and relations upon whom she is accustomed to lean for sympathy. Improvement in many cases begins as soon as this is done, as she begins to get back the self-control which she has surrendered to them. The nurse must be gentle but quite firm, and must strictly enforce obedience to the doctor's orders. Good food and attention to the bowels are essential. Cold baths or douches and electricity are often of great use. A careful watch must be kept in those cases where paralysis is simulated, as movements may be detected when it is thought that no one is looking. Where there is inability to take food, a watch must be kept to find out if it is procured secretly, or to find the source of blood which is spat or vomited up, as sucking the gums or biting the lips is sometimes practised by these patients unobserved.

Delirium is a mental derangement which is met with in many conditions. In prolonged feverish states with great weakness, such as typhoid, pneumonia or erysipelas, it is seen as the result of mental exhaustion, also in weakness from severe hæmorrhage; it is also seen in heart and kidney disease, and affections where the brain is involved. Delirium is said to be " passive " or " quiet " when the patient lies muttering to himself, fails to recognise those around him unless his attention is aroused, has mild delusions of sight and hearing, and plucks aimlessly at the bedclothes, or goes through motions as if he was gathering flowers from the air. It is called " active " delirium when he attempts to do things, such as to get out of bed, dress himself, climb out of the window, or is violent under restraint,

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shouting and swearing at those who restrain him. In the worst cases suicide may be attempted.

Delirium Tremens is the derangement resulting from the taking of too much alcohol. It should be understood that it need not be the result of violent drinking. For instance, a man may habitually take more alcohol than is good for him, and never appear in any way the worse for it so long as he is leading an active open-air life, but if he breaks his leg or is suddenly laid up from some cause, that man is very likely to exhibit symptoms of delirium tremens. The condition is met with in the most unexpected circumstances and in those one would least suspect of intemperance, but the nurse should always recognise such a state of affairs as soon as symptoms appear.

Symptoms.—The patient at first is restless and irritable, especially towards night-time, finds the confinement irksome, and begins to refuse food, his hands tremble, so does his tongue when protruded. After a day or two active symptoms appear, he begins to have quiet delirium, talks to himself, brushes imaginary things away with his hands. In mild cases nothing more serious may develop, and during the day the patient may be rational. In severe cases, however, the quiet rapidly changes into the most active delirium. Horrible dreams and visual hallucinations haunt his imagination, snakes, rats and devils crowd around him and from these he vainly struggles to escape. He is noisy, violent and difficult to control, and attempts to get out of bed.

Management.—The nurse should report at once to the doctor any indications of the onset of symptoms. She has to be most careful not to hint at

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the real nature of the trouble to the friends. Tact, attention and perseverance are needed in these cases.

The patient must be induced to take food, the bowels must be got to act, and the patient humoured but kept as quiet as possible. The mild cases give little trouble. In the severer cases two people will be required probably to pacify and control the patient; force and contradiction will excite him more than ordering him firmly back to bed, and persisting till he lies down, for the patient's determination is weak and he has little permanent will power. For the violent cases, capable male assistance must be obtained, and where there are threats made against attendants or suicidal tendencies noted, the fire-irons, razors, crockery and any other things possible to use as weapons should be removed from the room.

Insanity.—There is no need to attempt a description of any of the many varieties of insanity, the care of insane people is undertaken in special institutions. Should a person suddenly become insane and need restraint, the same methods must be adopted as for the control of those suffering from delirium tremens. If the patient is a pauper application must be made to the relieving officer of the district, but a certificate is needed from a doctor and a magistrate before the patient can be admitted to an asylum. In private cases two certificates are needed, each signed by a doctor who has visited the patient and examined him independently. Only in cases of urgency can a lunatic be confined on an emergency certificate which is signed only by one doctor, in which case the regular certificates must be filled later.

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CHAPTER V

THE CIRCULATORY SYSTEM AND THE BLOOD

THE circulatory system consists of the fluid blood, the heart which pumps it along, and the blood-vessels, arteries, veins and capillaries in which it is conducted to all parts of the body. To these must be added the lymphatic system.

The Pericardium is a thin sac which surrounds the heart, and contains a small amount of fluid, which lubricates the surface of the heart and allows free movement of the organ.

The Heart.—The heart is a hollow pear-shaped muscular organ about the size of a clenched fist, situated in the thorax between the two lungs. It lies behind the breast bone rather to the left of the middle line, with the broad end or base uppermost, and the apex or pointed end downwards and to the left. The apex can be felt beating in the fifth intercostal space, below and internal to the left nipple.

The heart is divided into two halves, right and left; in the adult heart there is no communication between the two halves, except by means of the blood-vessels. Each half is again divided into an upper compartment called the auricle, and the lower called the ventricle. Each of these compartments has the terms right and left applied to it, according to the side to which it belongs.

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The right side of the heart receives the venous blood from all over the body and drives it through

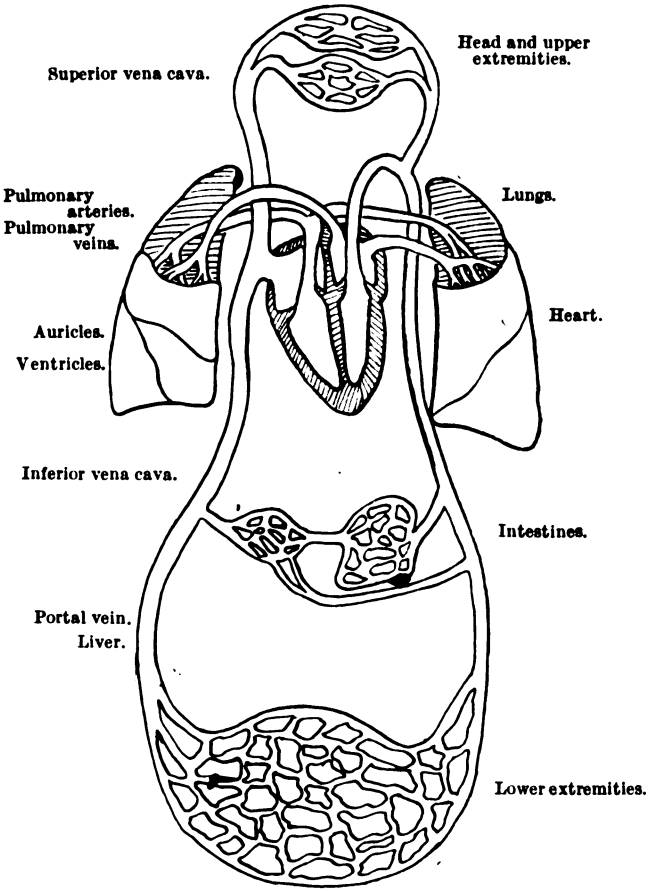

Fig. 15.

the lungs to the left side of the heart, the left side drives the blood to all parts of the body, from

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whence it returns to the right side again. The right side having less work to do than the left side, its chambers are only about one-third the thickness and strength of those on the left side.

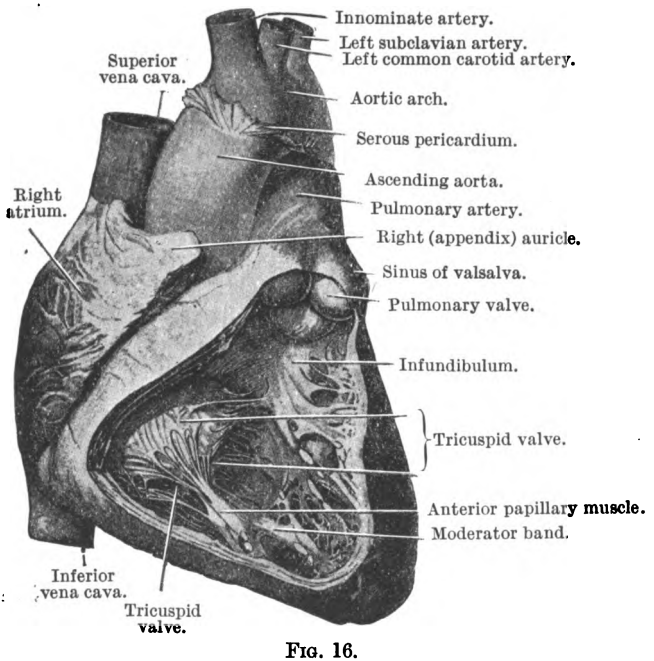

FIG. 16.

The *Right Auricle* receives the blood by two large veins called venæ cavæ. The superior vena cava brings the blood from the two upper limbs and from the head, neck and chest wall, the inferior vena cava the blood from the abdomen and the two lower limbs.

Mechanism of the Heart.—When the right auricle

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contracts the blood passes downwards through a large opening into the right ventricle. As this opening is guarded by a three-flap valve it is called the tricuspid orifice.

The *Right Ventricle* has thicker walls than the auricle, and the flaps of the tricuspid valve can be seen hanging down into it, their margins being

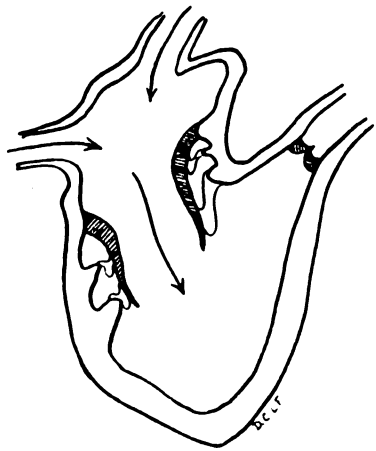

FIG. 17.—Diagram showing position of the valves when the auricle is driving blood into the ventricle.

attached by tendinous cords to small muscular processes, which stand out from the muscular walls. When the right ventricle contracts the valves meet and shut off the right auricle, preventing any return of the blood through the opening. The blood is therefore driven through another opening in the upper and front part of the ventricle into the pulmonary artery. This pulmonary orifice is guarded by three half-moon-shaped or semilunar valves, which allow the blood to pass out, but prevent the

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blood passing back again into the ventricle. The blood is in this way driven on through the lungs, and returns to the left side of the heart in the pulmonary veins.

The *Left Auricle* receives the blood from the pulmonary veins; when it contracts the blood passes into the left ventricle through an opening which has

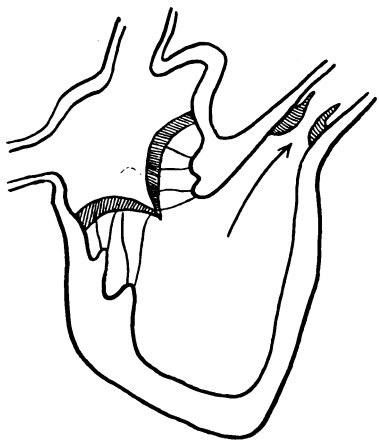

FIG. 18.—Diagram showing the position of the valves when the ventricle is contracting to drive blood into the aorta or pulmonary artery.

a two-flap valve, and is called the bicuspid or mitral orifice.

The *Left Ventricle* has a very thick wall, as it has to propel the blood through the vessels all over the body. When the left ventricle contracts it drives the blood into the aorta, which is the main blood-vessel of the body. The blood is prevented from escaping back out of the aorta into the ventricle by three semilunar flaps, just as in the case of the pulmonary artery.

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The Blood-Vessels.—The blood-vessels are of three kinds, arteries, capillaries and veins. The arteries convey the bright red blood from the heart and divide into smaller and smaller branches; the latter are called arterioles, and they in turn break up into capillaries. Arteries have three coats, an outer one of strong fibrous tissue, a middle and thicker one of muscular and elastic tissue, and an inner thin and smooth one which is in contact with the blood.

FIG. 19.—Diagram of capillaries.

The capillaries only have one coat, which is continuous with the inner coats of the arteries on the one side and of the veins on the other, so that the blood is only kept from the tissues by this thin membrane. This allows the fluid part of the blood to pass out, and also allows a free exchange of the gases of the blood and tissues to take place. As the oxygen passes out to the tissues, and as the carbon dioxide of the tissues passes into the blood, the blood in the capillaries soon loses its bright red colour and becomes dark purple. The blood as it runs on is collected into the veins, small ones at first which join together so that larger and larger veins are formed, till they end either in the superior or inferior

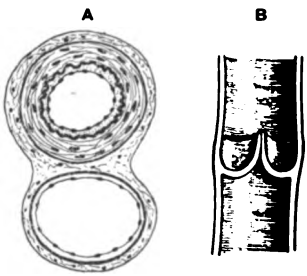

FIG. 20.—Diagram showing artery and vein A and valves in vein B.

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vena cava, which are the largest veins of the body. The veins, like the arteries, have three coats, but these coats are thinner and not so strong.

The *Aorta* is the largest artery of the body, through which the whole of the body, excepting the lungs, is supplied with blood. It commences at the left ventricle near the front of the chest, and arches over the heart till it reaches the thoracic vertebræ, thence it runs downwards behind the heart through the diaphragm to enter the abdomen and continues downwards, lying just in front of the lumbar vertebræ a little to the left of the middle line of the body, to end just below the level of the navel by dividing into the two common iliac arteries.

The entrance to the aorta is guarded by three semilunar valves, behind two of which are the openings of its first branches, the right and left coronary arteries which supply blood to the heart itself.

The arch of the aorta gives off three large branches, the innominate, the left common carotid and the left subclavian arteries. These three vessels between them supply the head and neck and the two upper limbs.

The Innominate Artery is a short vessel which ends behind the inner end of the right clavicle by dividing into the right common carotid and the right subclavian.

The Upper Limb

The Subclavian Arteries convey the blood to the two upper limbs, that on the right arises from the innominate, that on the left from the arch of the aorta. They both end at the outer border of the first rib on

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their own side of the body by becoming the axillary artery.

The Axillary Artery passes from the root of the neck outwards and downwards under the middle of the clavicle to the axilla, at the lower border of which it becomes the brachial.

The Brachial Artery runs downward on the medial side of the arm to end in front of the elbow joint, so that it gradually comes to lie more on the front than on the medial side. The course of the artery is along the medial border of the biceps muscle, this is the prominent muscle on the front of the arm, the inner border of which can easily be seen in a well-developed arm. At the bend of the elbow the brachial artery divides into two branches, the radial and the ulnar.

The Radial Artery runs down the front of the lateral aspect of the forearm, towards the thumb, and lies close under the skin just above the wrist, and is there used to ascertain the state of the pulse.

The Ulnar Artery runs down the front of the medial side of the arm to end in the hand by bending outwards, across the middle of the palm, to join with branches of the radial artery to form the palmar arch. From the palmar arch branches pass down to the sides of the fingers.

The Lower Limb

The two Common Iliac Arteries convey blood to the pelvis and to the lower limbs. They pass outwards and downwards to the middle of the groin, but divide after a course of about two inches into the hypogastric and external iliac vessels. The hypogastric artery passes into the pelvis and supplies the

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organs there situated, and gives branches backwards to the buttock. The external iliac artery continues the line of the common iliac, and passing under the inguinal ligament (the ligament of Poupart), which divides the abdomen from the thigh, it passes into the thigh and becomes the femoral artery.

The Femoral Artery lies in front of the thigh above, and rather to the inner side, half-way down the thigh; it is well on the medial side. About the junction of the middle and distal thirds of the thigh the artery passes through the muscles to the back of the limb, where it becomes the popliteal artery.

The Popliteal Artery runs down the back of the knee and ends by dividing into the anterior and posterior tibial arteries.

The Anterior Tibial Artery passes forwards between the two bones to the front of the leg and foot, down which it runs to the proximal end of the space between the first and second metatarsals, where it passes into the sole of the foot. In front of the level of the ankle joint, the anterior tibial artery changes its name, to be called the dorsal artery of the foot.

The Posterior Tibial Artery runs down behind the tibia to the medial side of the ankle joint, where it divides into the lateral and medial plantar arteries which supply the foot and toes. The posterior tibial artery gives off the *peroneal artery* high up in the leg, and this vessel runs down the limb behind the fibula, at the lower end of which it ends.

The Head and Neck

The Common Carotid Arteries supply blood to the head and neck, that on the right side is given off

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by the innominate artery, that on the left comes from the arch of the aorta. They run up the side of the neck to divide opposite the upper border of the larynx into the internal and external carotid arteries.

The External Carotid Artery breaks up into branches which supply the face and scalp. The external maxillary artery may be felt passing upwards over the mandible about one and a half inches in front of the angle of the bone. The common *Temporal* artery runs up just in front of the ear, and a large branch passes forwards and can be felt beating at the side of the forehead.

The Internal Carotid Artery passes upwards deep in the neck to enter the base of the skull, and supplies the brain with blood. Some of its branches pass through the orbit, supplying the eye, and some pass out of the orbit on to the front of the forehead.

The Blood

The blood consists of two parts, a pale straw-coloured fluid called the liquor sanguinis and millions of solid bodies called corpuscles. These fluid and solid parts are about equal in weight, and of the two the solids are the most important.

The Blood Corpuscles are of two kinds, red and white. The red corpuscles are small circular discs, concave on both sides with a diameter of only $\frac{1}{3200}$ of an inch. In a cubic centimetre, which is about the size of a pin's head, there are 5,000,000 of these corpuscles. They give the thickness to the blood and also the red colour, though when seen under the microscope each corpuscle has only a faint yellow tint.

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The Red Corpuscles of man and other mammals do not possess a nucleus, but those of other animals, such as birds or fishes, do; man's blood, therefore, can easily be told from blood of the latter, but not from that of mammals. The corpuscles are highly elastic, and this enables them to pass through very small apertures into the tissues during inflammatory processes.

The White Corpuscles are a little larger than the red, being about $\frac{1}{2500}$ inch in diameter. They are ordinary cells of protoplasm with a well-marked nucleus, and can move about from place to place, and have the power of passing very easily through the walls of capillaries. They are far fewer than the red cells, being normally only about 5000 to a cubic centimetre of blood. They increase greatly in certain circumstances, especially when suppuration is taking place, as it is these which migrate in large numbers to the septic area and attack the bacteria.

The Coagulation or Clotting of Blood is a natural process by which the blood thickens so that it blocks the end of the vessels from which it is escaping, and so arrests the hæmorrhage. What happens is as follows: after blood is shed, and becomes stationary, the red corpuscles run together to form rouleaux, that is to say they stick together by their flat sides, making long columns. A network of fine filaments gradually appears all through the blood, turning it from a fluid into a jelly. This will happen in the space of about two minutes. If the blood is in a glass vessel and is allowed to stand, the jelly begins to contract and squeezes out the fluid part, so that at the end of a few hours a small tough

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dark clot is seen floating in a clear yellow fluid called the serum. The clotting is due to the formation of this network of fibrin, and the squeezing out of the serum by the contraction of the fibrin. In the meshes of the fibrin are entangled all the blood corpuscles.

Fibrin is not present in blood before it is shed; the elements which form it are in solution, but need a ferment to make them unite to form the fibrin. This ferment is formed immediately blood comes in contact with surfaces to which it is not accustomed, such as cut tissues, skin, clothes, etc.

Hæmoglobin is a compound which contains a large amount of iron, it gives the colour to the red corpuscles. Hæmoglobin is important, as it has the power of uniting with oxygen in a very feeble compound whenever it is exposed to the gas. As the blood flows round the air cells of the lungs, the hæmoglobin unites with the oxygen of the air, and the blood becomes scarlet in colour. This oxygen compound then passes to the heart and so to the whole body, where the oxygen is easily abstracted from the hæmoglobin by the tissues which need it to burn up the carbon in the fats and sugars to form carbon dioxide and water. The hæmoglobin deprived of its oxygen turns a dark purple colour. The carbon dioxide is carried to the lungs chiefly in the fluid part of the blood and not by the corpuscles. From its facility in uniting with, and parting from, oxygen, hæmoglobin is known as the oxygen carrier. The quantity of blood is usually said to be about one-tenth of the total body weight.

The functions of the circulation are many, as it is

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intimately connected with every organ in the body, but the chief ones are—

1. It carries oxygen from the lungs to the tissues, in which oxygenation or burning up of the food takes place.
2. It carries the results of oxygenation and the waste products to the organs for excretion—the lungs, kidneys and liver.
3. It is the medium by which fresh fuel in the shape of food is carried to be stored or used in the different organs.
4. It distributes heat evenly throughout the body.
5. It conveys to all parts of the body substances prepared in special organs.

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CHAPTER VI

HEART DISEASE

DISEASE of the heart is a term applied when for any reason the organ is not performing its function of driving on the blood through the blood-vessels. This may be due to several causes—

1. Inflammation of the heart muscle from pericarditis.
2. Weakness of the heart muscle from degeneration.
3. Valvular disease where there is inefficiency of the valves.

Before dealing with these in detail we may consider the main symptoms caused by inability of the heart to act properly.

Symptoms of Heart Disease.

1. *Dyspnœa* or difficulty in breathing is often very marked. In its simplest form it is an increased rapidity of respiration. This may not be noticed when the patient is at rest, but marked breathlessness occurs on any action which involves the slightest exertion, such as hurrying or going upstairs, the rate then rising to thirty to forty or more per minute. In slight cases a short rest is sufficient to allow the breathlessness to pass off and progress can then be

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continued. In the later stages of heart disease, dyspnœa is a constant and distressing symptom, even when the patient is lying in bed; often he cannot tolerate the recumbent position and has to be propped up with pillows, sometimes he has to sit up straight to ease his breathing, and may have to be maintained in this position even when asleep. The result of the difficulty in breathing is seen in the deficiency in the aeration of the blood, for the patient becomes very cyanosed and there is blueness of the face, especially the lips, nose and ears, while the hands and feet are also livid.

Palpitation is the name given to the peculiar fluttering sensation felt in the chest when the heart is beating rapidly and irregularly. It is very usually associated with dyspnœa, and is brought on as a rule by the same causes. Like dyspnœa, too, it may come on when the patient is lying at rest. It is accompanied by a feeling of faintness, which is very alarming to the patient, who gets nervous, and so makes matters worse. The condition usually passes off in a minute or so. The way to control it is to stand still or sit down if exercise has been the cause, while a drink of water, a little stimulant or smelling salts may be used with benefit.

Fainting occurs when from any cause the supply of blood to the brain becomes insufficient for its needs. The circumstances which cause this are very numerous. Weakness of the heart, sudden emotion, over-exertion of the heart, prolonged standing when in weak health, exposure to cold or hot and stuffy atmosphere, and sometimes indigestion.

Fainting may take place without the patient

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having any warning, but this is not usual, more often there is a distinct feeling of unrest and uneasiness, sometimes almost nausea, there may be a feeling of intense heat or cold, and free perspiration, with a great tendency to yawn and sigh continually.

Management.—The attack can be staved off at this stage by prompt action on the part of the sufferer or his friends. Any one feeling that they are going to faint should inform some one, so as to obtain assistance; especially is this to be done when in a crowd. In every case the head is to be lowered at once so as to increase the blood supply to the brain. If the person can lie down he should do so; if he is sitting, and lying is impossible, he should lean forward so that his head is well down between his knees. If standing, simply bending down as if to tie a bootlace, and remaining in this position some time, may be sufficient to cause the feeling to pass off. Whatever is done should be done promptly while will power is still left. If a person is allowed to fall heavily in a faint he may sustain considerable injury by striking his head against some object.

When a person has fainted, he should be turned over on his back with his head low, his collar, tie and waistcoat loosened, and people should be prevented from crowding round. In most cases nothing more is required, and in a very few minutes consciousness will return, but the patient should be made to lie still for some time longer, or the faintness will return. Stimulants are very useful at this stage, brandy, whisky or sal volatile. The patient is sure to feel weak and queer for some half-an-hour after a faint, and should be persuaded to keep quiet.

Dropsy is caused by the fluid parts of the blood

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leaving the vessels and collecting in the body cavities and loose connective tissues. As a result the cavities are distended and the viscera displaced. The connective tissues become pale and swollen, so that if the finger is pressed on the part for a moment a pit is seen on taking it away—this is termed pitting on pressure. *Œdema* is the name given to

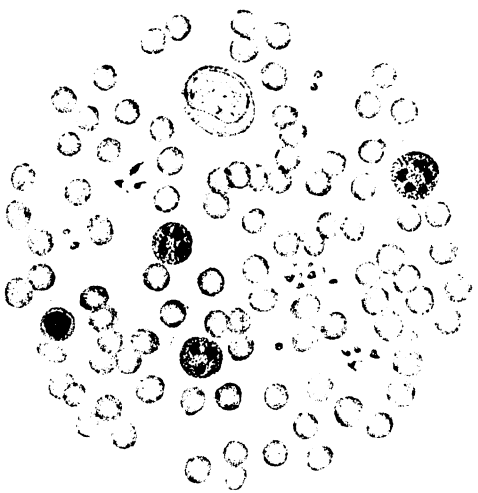

FIG. 21.—Microscopical appearance of the blood.

this distension of the connective tissues with fluid. It is very much more marked in the dependent parts and therefore is most frequently seen in the feet and legs, especially towards evening, if the patient has been up and about all day. *Ascites* is the term applied to the collection of fluid in the abdominal cavity. The abdomen becomes distended, the intestines are floated up to the upper part, while the fluid collects in the pelvis and lower

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part; when the patient lies upon the back the two flanks may be seen bulging out with the fluid. If the distension is great the movement of the diaphragm becomes embarrassed and breathing is difficult and rapid.

Management.—Often the body becomes as it were water-logged, for as the patient gets weaker the weight of the limbs increase, until he can no longer control them. Such people, while being very helpless, are extremely difficult for a nurse to manage and to lift from one position to another. Considerable assistance may be obtained by fixing to a ring in the ceiling a loop of rope by which the patient can help to pull himself about.

Tapping the Limbs.—In great swelling of the legs it is sometimes necessary to draw off the fluid. The skin is carefully disinfected, and either pricked with a bundle of clean needles or small incisions are made, an antiseptic fomentation is then applied and the fluid allowed to drain into it. Considerable quantities may be drawn off in this way. Another method is to insert one or more small silver tubes (Southey's tubes) into the tissues, and fix them in place by strapping, to the tube is attached a length of fine rubber drainage tube leading to a receptacle. Many pints of fluid may be drawn off in the twenty-four hours by these tubes. Strict cleanliness is imperative, or cellulitis or erysipelas may be started.

Tapping the Abdomen may be necessary, and to do this the patient should always be in bed. The nurse should see that the patient empties the bladder beforehand, and should inform the doctor on this point. She also prepares a broad many-

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tailed bandage to go round the abdomen, this is better than a binder. Large receptacles are necessary to receive the fluid, and a mackintosh and antiseptic towel should be arranged to prevent leakage into the bed. Stimulants should also be to hand.

The doctor makes the puncture as a rule in the middle line below the umbilicus. As soon as the fluid begins to flow freely, the many-tail may be put in place and gradually tightened tail by tail, as the bulk of the abdomen diminishes. By keeping up firm pressure in this way the faintness which some patients experience is avoided.

The puncture is sealed by gauze and collodion, and the patient should remain in bed and wear the bandage for several days.

Causes of Heart Disease—Compensation. Heart disease is seldom a primary disease, it is usually secondary to some other cause. The commonest and most serious of these causes is rheumatic fever or acute rheumatism, which may attack both the pericardium and the valves of the heart. Next to rheumatism comes overstrain. Now, overstrain may be due to violent muscular work, in which case the left side of the heart will be chiefly affected, or to obstruction in the lungs from chronic bronchitis or emphysema, or to inefficiency on the left side of the heart, which will cause overstrain of the weaker right side. The third great cause of heart trouble is infection carried to the valves of the heart by the blood during the course of one of the specific fevers such as typhoid, or during the course of a septic infection it may be from a wound. The infected valves become ulcerated and partly de-

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stroyed, so that they fail to act as efficiently as before, and some leakage backwards of the blood occurs between the flaps.

About three ounces of blood are normally pumped forwards at each beat, if, however, half an ounce or more leaks back through the valves, the heart must beat more rapidly and more forcibly to perform the same amount of work. As a direct result of this increased labour a change takes place in the heart. This change is called compensation, as it compensates for the difficulties under which the heart now acts. Compensation takes the form of hypertrophy of the muscular wall, so that more power is available to drive the blood along, the heart wall becomes much thicker and the cavity becomes dilated so that more blood, say three and a half ounces, is driven out at each beat, and it does not matter now if half an ounce does escape back. The whole heart enlarges, and, in consequence of this, enlargement is a sure sign of something being wrong.

Owing to the increased force of the beat the heart sounds, which are caused by the closing of the valves, become louder, and where leakage is taking place the sounds become changed and the flow of blood over the roughened surfaces can be heard with a stethoscope. By means of this compensation, a person with valvular disease of the heart can quite well go about his business although his heart is working almost at the top of its power and has probably very little reserve force, but he must, therefore, take things quietly, and not perform violent efforts such as running for a train, nor should he give way to violent emotion, for in both of these the heart has to beat far more

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rapidly than ordinarily. The normal heart can do this easily, the diseased heart cannot with safety, and may be unable to do so at all. If much work is continually thrown on a diseased heart, compensation will go on to a point beyond which it cannot go, and then the compensation is said to fail and give way. The effects of this failure are most serious dyspnœa, dropsy and sleeplessness rapidly appear, and sudden death may take place.

Pericarditis.—The pericardium, or bag in which the heart is contained, is lined with a smooth shining membrane. This membrane is continued on to the heart and forms a thin transparent covering to the heart muscle. The membrane secretes a small amount of fluid which lubricates the opposing surfaces of the heart and pericardium, so that they move on each other with very little friction. Inflammation of the smooth membrane, both on the pericardium and on the heart, is called pericarditis. The disease is set up by acute rheumatism or by septic organisms. The surfaces become roughened and rub against each other, so that a thrill can be felt when the hand is placed upon the chest. The amount of fluid secreted may be enormously increased, so that the heart becomes embarrassed in its action, while if the inflammation is intense and spreads deeply into the heart muscle, the force of the contraction is seriously diminished. The fluid may become pus.

Symptoms are usually insidious and come on during the course of rheumatic fever, or when suffering from some focus of sepsis. In the more acute forms there is fever, perhaps a rigor, pain in the chest, difficulty in breathing, and feebleness of

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the pulse. As the effusion progresses the action of the heart becomes weaker and more irregular, there is more difficulty in breathing, and a tendency to faint, and the pulse becomes more feeble, the skin more livid and the sweating is profuse. Death is apt to occur suddenly from heart failure, and where recovery takes place the heart is often permanently crippled by adhesions between it and the pericardium.

Management.—It is the fear of this complication ensuing on acute rheumatism which causes such precautions to be taken in that disease. Patients suffering from pericarditis should not be allowed to sit up on any pretext, they must not exert themselves or strain in any way. If the bowels are constipated an enema should be given to prevent straining. For the pain, and to reduce the inflammation, hot cloths or leeches may be applied to the heart; blisters are a favourite remedy in rheumatic fever to prevent the onset of the inflammation. Occasionally it may be necessary to tap the pericardium to draw off the fluid or to put in a drain to allow the pus to escape.

Valvular Disease has already been mentioned, together with some of its causes. Any of the four sets of valves may be effected, but in the majority of cases in adults it is the valves on the left side of the heart which are attacked, these are the mitral and the aortic valves.

1. *Mitral Disease* is the commoner of the two, and affects quite a large number both of men and women, who go about their business as if there was little the matter with them. They are enabled to do this by means of the compensatory changes which have taken place in the heart. These indi-

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viduals are careful of themselves and may have to lie up and be more careful over slight ailments than their neighbours, but they can do their work and live to a fair age. As they get old they require more and more done for them and often have to seek the aid of a trained nurse. If they overstrain themselves so that the heart is at all upset, they may have to lie in bed for weeks doing nothing while the heart recovers itself.

Complications are liable to carry these people off, pulmonary troubles being most feared, as these patients nearly always have a certain amount of chronic bronchitis and cough, which may be aggravated at any time and start a pneumonia. This is the more likely if rest in bed becomes necessary from any cause. Œdema of the feet shows itself first, and later there may be ascites. Often there is a trace of albumin in the urine.

Symptoms are chronic cough from the chronic bronchitis and congestion of the lungs, dyspnœa and lividity. In fact the colour of the face and the distension of the small veins of the cheeks and nose are often very characteristic. Hæmoptysis and hæmatemesis are sometimes seen and may have a very beneficial effect in relieving the congestion of the lungs and liver.

Management.—None is needed while compensation remains adequate, but when this fails and the symptoms just enumerated show themselves, the patient should remain quietly in bed, on a light diet, the bowels being kept freely open by mild aperients. As a rule the patient is ordered some digitalis, which has an excellent effect in slowing and strengthening the heart-beat. Especially is

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digitalis useful in cases where there is œdema or ascites, as under its influence the kidneys will increase the amount of urine excreted from the body. The amount passed in twenty-four hours should be carefully measured and the effect of the drug watched. To produce its full effect, the drug has to be given in large doses, and occasionally unpleasant effects are seen in those who do not tolerate it well. The nurse should recognise the symptoms, they are nausea, and giddiness, loss of appetite, failure of sight, irregularity of the pulse and faintness, with diminution in the quantity of urine secreted.

As the heart recovers its tone the patient can be allowed up again, but the amount of work allowed him to do is very carefully graduated. Death from this condition usually supervenes from the severity of the lung troubles or from gradual failure in the strength of the heart muscle. Children are often affected as well as adults, and in that case the outlook is poor, as they cannot indulge in the ordinary rough and tumble which is so valuable in developing the body. The majority who are affected in childhood die young, while those who live cannot earn their livelihood by manual labour.

2. *Aortic Disease* is more common in men than in women and is not met with in children. It is usually found as the result of overwork in those whose heart has been injured by rheumatism; it is therefore often found in conjunction with mitral disease. In severe cases there is considerable amount of leakage from the aorta back into the left ventricle. When the disease is well established

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and the valves very inefficient there is great risk of death following some sudden exertion.

Symptoms.—Those who suffer from this condition are usually pale and anæmic looking, the pulse-beat is felt to be very sudden and short, the arteries as a rule are thickened, there is shortness of breath and faintness on exertion; sleeplessness and restlessness are very common.

Management.—People who suffer thus must take the greatest care of themselves, so that they can perform their duties methodically and without hurry and fuss. Rest should be taken on the onset of pain in the chest, breathlessness or faintness. Death as a rule is very sudden.

Fatty and Dilated Heart. — What is called fatty heart occurs in stout people who have laid on a considerable amount of fat everywhere. In such people quantities of fat are deposited on the surface of the heart, and the fatty tissue burrows in among the muscle fibres so that the contractions are interfered with. In addition to this infiltration of the heart muscle with fat, actual degeneration of some of the muscle fibres takes place, and they are converted from muscle into fatty tissue. Both these changes causes weakness of the heart wall, so that the ventricle gradually becomes distended under the strain. The more the ventricle distends the more blood it contains, and the more difficult it becomes for it to empty itself; the condition, therefore, becomes progressively worse, until the weakened heart can no longer contract and sudden death is the result.

These excessively fat people can take little exercise, for movement is laborious on account of

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their weight. They are liable to suffer from chronic bronchitis, dyspnœa and dropsy.

Management.—These people should be strictly dieted so as to reduce their weight, at the same time carefully supervised and graduated exercises should be carried out while lying in bed, with a view to tone up their heart muscle. As the weight decreases and the heart improves, they may be allowed up, and the character of the exercises changed to suit the new conditions. Courses of baths are sometimes very efficacious.

Congenital Heart Disease is sometimes seen in the newly-born child, and is the result of imperfect development of the heart, whereby the right and the left sides of the heart do not become completely separated off from each other, as they should do soon after birth. As a consequence of this the blood can gain the left side of the heart without having to travel through the lungs; the blood, in consequence, is not subjected to the interchange of gases in the lungs, and therefore the ordinary blood pumped into the aorta for the use of the body contains too little oxygen and too much carbon dioxide.

Symptoms consequent on these changes are very much what one would expect. The child looks livid, the face, hands, and feet are very blue, hence the name of "blue babies" often applied. The breathing is more rapid than usual and the ends of the fingers become broadened out and club-shaped. If the children thrive they suffer from the cold and have to be well wrapped up to compensate for their impeded circulation. The great majority either die soon after birth from convulsions or bronchitis, or succumb to the infectious diseases of childhood.

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CHAPTER VII

HÆMORRHAGE

Definition.—Hæmorrhage means any escape of blood from the blood-vessels. Many other names are, however, in use to denote certain particular forms of hæmorrhage. The following are the most important—

In Effusion of Blood, the blood escapes from the tissues and is seen externally.

In Extravasation of Blood, the blood escapes into the tissues but not externally, as in a black eye; in such cases where the blood causes great swelling of the tissues the term *Hæmatoma* is used. *Petechiæ* are small subcutaneous hæmorrhages scattered over the body.

Bleeding from the nose is termed *Epistaxis*.
,, ,, lungs is termed *Hæmoptysis*.
,, ,, stomach is termed *Hæmatemesis*.

Blood in the urine is *Hæmaturia*, while *Melæna* means the passage of blood with the fæces.

Blood may escape either from the arteries, capillaries or veins, and effusion from each has certain characters.

In Arterial Bleeding.

1. The blood escapes in spurts, which correspond with the beating of the heart.

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2. The blood is bright red in colour.
3. Firm pressure on the bleeding point is needed to control it.

If an artery is bleeding in the depths of a deep wound from which the blood does not escape easily, only an even flow from the wound and no spurting will be visible.

In Venous Bleeding.

1. The blood escapes in an even flow from the wound.
2. It is dark purple in colour.
3. Slight pressure on the bleeding point will stop the flow.

In Capillary Bleeding.

There is merely an oozing from the whole of the raw surface of blood which is rather dark in colour. The bleeding usually stops without the aid of any pressure.

Note.—It is sometimes said that in arterial bleeding a tourniquet should be put on nearer the heart than the wound, while in venous hæmorrhage it should be put on beyond the wound. A properly applied tourniquet placed between the heart and the wound stops all blood going to the wound, and therefore controls any form of hæmorrhage.

It is true that in superficial veins pressure just beyond the wound will often stop the flow, but this is not always the case, as in varicose veins of the leg. Pressure in every case, therefore, should be applied to the bleeding point, and if necessary, nearer the heart as well.

Symptoms.—Where effusion of blood takes place the symptoms of hæmorrhage are of little value in diagnosing the condition as the blood can be seen; but the bleeding may take place unseen into one of

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the cavities of the body, and the person may bleed to death before the condition is diagnosed. This form of bleeding is known as *Concealed* or *Internal Hæmorrhage*, and is very dangerous. It is most important, therefore, to remember the signs and symptoms of hæmorrhage, in order to recognise when concealed hæmorrhage may be taking place. Concealed hæmorrhage may take place after injuries or operations into the peritoneal or pleural cavities, the stomach, intestines, rectum or bladder. In enteric or typhoid fever it may take place into the intestines without any warning. The progressive nature of the signs should be specially noted. They are—

1. Increasing pallor of the skin and mucous membranes, coldness and sweating of the skin.
2. Increasing softness and rapidity of the pulse.
3. The quickened and sighing nature of the breathing.
4. Breathlessness, wandering speech and occasionally vomiting.
5. Subnormal temperature.
6. Attacks of faintness and fainting.
7. Dilated pupils and sometimes loss of vision.

If these signs are noted after an accident or an operation, the surgeon should be informed immediately.

The Natural Arrest of Hæmorrhage. — This takes place in two stages—first the temporary arrest and then the permanent closure of the vessel.

(A) The temporary arrest of hæmorrhage is brought about by three principal factors.

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1. The coagulation of the blood, which takes place as soon as it is shed, the process of which has already been described. Without this coagulation, severe bleeding would follow the slightest scratch.
2. Diminution of the heart's action takes place owing to the anæmia of the brain, so that the force by which the blood is driven along the vessels is lessened. If fainting occurs the heart's action becomes extremely feeble, so that the flow almost ceases, and the changes described under heading 3 can easily take place. Stimulants, by increasing the heart's action, seriously increase the hæmorrhage.
3. The changes in and around the vessel are important. The vessel which is divided, being elastic, immediately retracts within its sheath, and at the same time the cut end contracts so that the opening becomes much smaller. The blood coagulates in the tissue round about and between the vessel and its sheath, preventing the vessel dilating—this is called the external coagulum—and also clots inside the vessel as soon as the flow begins to stop—this is the internal coagulum, and serves to plug the end of the vessel. No more blood can escape as long as the internal coagulum remains undisturbed.

(B) The permanent closure of the artery is really a part of the general healing and closure of the wound. When the bleeding stops the internal coagulum, dark red in colour, extends from the cut

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end for a considerable distance up the vessel, even as far as the next branch above.

The vessel and the clot gradually contract and the process of inflammation begins, an exudation takes place into the tissues round, and cells begin to migrate into the clot, first from the cut ends of the artery walls and later from the sides, so that the whole mass, clot and artery walls, become infiltrated with granulation tissue, the round cells of which gradually change into fibrous tissue. By the same process the remainder of the wound is healed up.

The Treatment of Hæmorrhage. — The first great principle in the treatment of hæmorrhage is to prevent the further loss of blood. This in slight cuts is all that is required. In severe bleeding a good supply of blood to the brain must be assured, and immediate steps taken to replace the fluid lost.

The principles therefore are—

1. To stop the bleeding.
2. To ensure a good blood supply to the brain.
3. To replace the lost fluid.

1. **To Stop the Bleeding.** *First Aid in Hæmorrhage.*

(*a*) The wound must be quickly and thoroughly exposed, the depths plugged temporarily by whatever comes to hand, and firm pressure made over the pad thus formed. Here thoughts of possible sepsis must not be allowed to delay the arrest of the bleeding; a handkerchief, napkin or cloth must be applied at once. If the wound is in a limb, the limb should be elevated so that the blood has to run uphill.

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(*b*) If the wound is in a limb, while one hand makes pressure over the pad, the other hand can feel for the main artery of the limb and make pressure on that.

(*c*) The limb should then be held elevated so that the blood has to run uphill. By this means even severe arterial bleeding can be got under control.

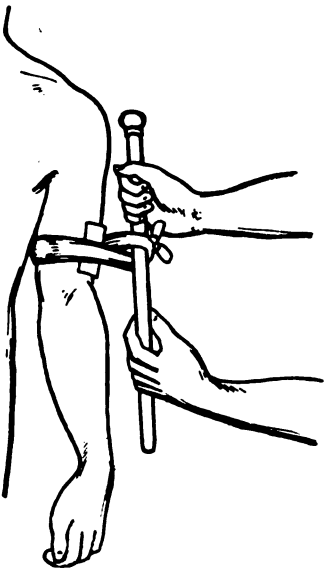

FIG. 22.—Improvised tourniquet.

(*d*) A messenger should now be sent to find and bring a medical man.

(*e*) While the limb is safely held by one person, another can improvise a tourniquet by knotting a handkerchief loosely round the limb above the wound, the thigh or upper

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arm. A pad made of cloth torn from the patient's clothing, or a smooth round stone is put in the handkerchief over the main artery and a short stick is put through the loop of the handkerchief on the opposite side of the limb, the skin at this point being protected by a strip of cloth. By twisting the stick the handkerchief can be made to constrict the limb and occlude the artery. The tightness can be gauged by feeling the pulsation disappear from the vessel just below the tourniquet. With a second handkerchief the stick can be fixed to the limb to prevent untwisting. No further hæmorrhage can now take place and the patient can be laid on a bed with the limb propped up, and the head low, so that what blood is left will easily reach the brain. Preparations can then be made for dealing with the wound, such as boiling handkerchiefs and linen to be used as dressings, or preparing antiseptics. When all is ready the temporary plugging can be removed (no bleeding can now occur), and the wound cleansed. A *graduated compress* can be made by using small pieces of linen or lint laid in the wound one on the other, each succeeding one being a little larger than the previous one, so that firm pressure is made even in the depths of the wound. The whole is secured by a bandage.

Tourniquets.—Besides the improvised tourniquet already described, many special instruments are

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usually found in hospitals and in the surgical haversacks carried by soldiers.

1. The simplest of these is the elastic tourniquet, which consists of a thick piece of india-rubber

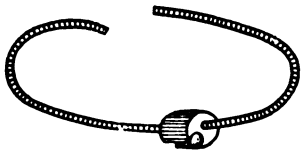

FIG. 23A.

tubing which is wound tightly two or three times round the limb, and secured in place by knotting the ends. Sometimes the india-rubber is solid and the ends fitted with hooks

FIG. 23B.

or other contrivance, to enable them to be fastened together. Unfortunately, the rubber perishes with keeping, and is therefore liable to break.

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2. The screw tourniquet is more complicated, but is the one supplied to the services, and has the following parts—a pad, a band, and a screw arrangement for tightening it. The pad is applied over the artery, the band buckled round the limb and the screw used to tighten it. Care must be taken that the pad does not slip from its position over the artery.

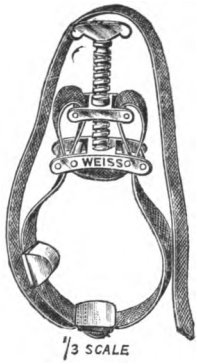

FIG. 24.

3. The making of improvised tourniquets should be practised, as in most cases these special instruments are not to hand. The puggarees of helmets, puttees and the straps and belts of a soldier's equipment are most useful in dealing with cases of hæmorrhage in the field.

Special Points in the Application of Tourniquets.

1. The pressure should not be greater than is just sufficient to stop the bleeding, greater pressure than this causes unnecessary pain and may damage the nerves of the limb.
2. Tourniquets can only be used for bleeding from the limbs. For first aid they should only be applied round the upper arm or round the thigh, never to the forearm or the leg as in these positions they cannot control the vessels which lie between the two bones of these segments of the limbs.

The surgeon may sometimes use a special tourniquet round the shoulder, the pelvis, or the scalp while performing operations.

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3. Tourniquets should not be left on longer than necessary. If the limb is deprived of blood for more than three to four hours there is a danger of gangrene taking place. Special precautions are, therefore, to be taken where there are many casualties, as in railway accidents or during fighting, to see that tourniquet cases are attended to first. The person who applies the tourniquet should, when handing over the patient to the care of any one else, draw his attention specially to the fact that a tourniquet has been applied. If this cannot be done, a label with the word tourniquet written on should be attached to the patient so as to attract attention.

Other Methods of Dealing with Hæmorrhage

Venous Hæmorrhage. — This is more easily controlled than arterial hæmorrhage, as the blood stream is slower and less forcible. It is most common in varicose veins of the lower extremity—an exceedingly common complaint in women. Here the veins become adherent to the skin, which in turn becomes very thin and may rupture from a slight blow or during straining. The person may be quite unaware that anything has occurred, and faintness from loss of blood, or the sight of the blood may be the first intimation that bleeding is taking place. Want of knowledge and confusion may lead to serious loss and even death. The vein is diseased and the valves are usually destroyed so that blood escapes from both ends of the vessel.

Treatment.—All that is necessary is to lay the patient flat, elevate the limb, and apply slight

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pressure by means of an antiseptic compress and bandage. The garters should be removed and the limb bandaged from the foot to well above the burst vessel. A tourniquet need never be used.

Capillary Hæmorrhage is rarely dangerous, but a ragged wound often bleeds a good deal at first. If hot water about 115° F., which is about the heat the back of the ordinary hand can just bear, be poured over the wound, the bleeding will stop at once. But the water must be quite as hot as this, to cause the small vessels to contract. Warm water below 100° F., promotes the bleeding. A compress will always stop capillary hæmorrhage.

2. **To Ensure a Good Blood-supply to the Brain.**—The simplest way to do this is to lay the patient flat on the back on the floor, if on a bed or couch the foot end of the bed can be raised up six inches by slipping books under the feet of the bed. In severe cases the limbs may be bandaged to drive the remaining blood into the trunk, and a binder may be placed round the abdomen. Drugs, such as pituitrin, adrenalin and morphia are also useful.

3. **To Replace the Lost Fluid.** — The thirst which affects the wounded is one of nature's methods of attracting water to the system in cases where blood has been lost. If conscious, therefore, water may be given by the mouth. Another method of supplying fluid is to give an enema into the lower bowel. This can be done with a piece of tube or catheter to which a funnel or the barrel of a syringe is attached. Salt water, made by adding a teaspoonful of salt to a pint of warm water, is poured into the funnel and allowed slowly to flow into the rectum. This can be done without loss of time, and later the

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surgeon may introduce saline directly into the veins or into the subcutaneous tissues by means of a needle. This, however, necessitates strict antiseptic precautions and sterile solutions, so cannot be done in a hurry, except in nursing institutions.

The Three Forms of Hæmorrhage. — The hæmorrhage we have hitherto been discussing is known as *Primary Hæmorrhage* as it takes place immediately after the receipt of some injury. There are two other forms of hæmorrhage which may take place some time after the primary hæmorrhage has been arrested. They are known as (1) reactionary, and (2) secondary.

Reactionary Hæmorrhage is also known by the names of intermediary or recurrent hæmorrhage. It comes on during the first twenty-four hours from the injury. It is due to the failure of nature's methods for the temporary arrest of the primary hæmorrhage. The chief factors in its causation are as follows. When the hæmorrhage has been temporarily arrested by natural means, the heart gradually begins to beat a little stronger, and the blood pressure may be sufficient to drive out the clot. This will happen the more easily if the patient crawls or moves about, as the action of the muscles may loosen the clots. When this happens the vessel becomes re-opened, and bleeding will recur. This is the more likely to happen if stimulants, such as brandy, be given, as they cause the heart to react and beat much more violently, so that the blood pressure rises greatly, and at the same time cause the vessels to dilate, so that the clot may become loose. Hence the term reactionary hæmorrhage. For this reason alcohol should never be

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given in cases of hæmorrhage as death may take place from this second escape of blood.

Secondary Hæmorrhage is hæmorrhage which takes place any time after twenty-four hours has elapsed from the receipt of the injury. It is due to failure of the natural process of permanent arrest of hæmorrhage. Formerly it was very common, nowadays it is seldom seen. It is caused by sepsis. Bacteria break down and decompose the clot in the vessel before the granulation tissue has had sufficient time to close the open end. It is seldom seen, therefore, apart from septic wounds which have involved an artery. Such cases need careful watching. Warning is usually given by seeing a small amount of fresh blood on the dressings when these are changed, and such an occurrence should be reported at once to the surgeon. Antiseptic dressings should be applied, and the limb should be kept elevated. A tourniquet should be placed loosely around the limb, or kept close by in readiness for instant use. The part should be uncovered except for the dressings so that any bleeding will at once be visible. Should bleeding occur, it must be controlled at once by the tourniquet and the surgeon sent for. He may enlarge the wound and secure and tie the vessel or may even have to amputate the limb above the wound.

Diseases Associated with Hæmorrhage

1. *Hæmophilia* is a disease which affects certain families who are popularly known as "bleeders." In these people nature seems unable to bring about the temporary arrest of hæmorrhage even in slight injuries, which therefore continue to ooze blood for

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days until the sufferers actually bleed to death in spite of all treatment. Extraction of teeth, biting the tongue, or slight cuts may easily cause the death of these people. Spontaneous bleeding is liable also to occur from the nose, bowel or kidneys. From this cause the males of the family usually die in youth, but the disease becomes less pronounced as age advances; if they survive their children do not inherit the tendency. The females are rarely affected, but on the other hand they transmit the tendency to their children.

2. *Jaundice* is caused by obstruction to the flow of bile into the intestine. People suffering from this condition often bleed persistently. To prevent this calcium salts are often given before and after operations on the bile passages.

Where to Compress Arteries to Arrest Hæmorrhage. Upper Limb.—*Subclavian Artery.*

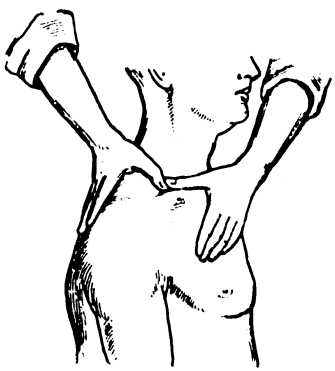

Fig. 25.

It is only necessary to compress this artery when the bleeding is coming from a wound in the arm-pit (Axilla). The patient should be lying on the back.

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The vessels may be compressed by the thumb or by wrapping the end of a piece of stick or the handle of a large door key in a handkerchief, and pressing downwards and backwards above the clavicle against the first rib.

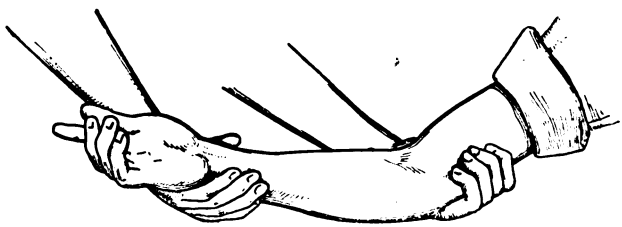

FIG. 26.

The Brachial Artery should be compressed for all bleeding below the axilla. It is best done by grasping the upper arm with the whole hand, the palm of the hand should be placed on the back of the arm with the fingers on the inner side, their

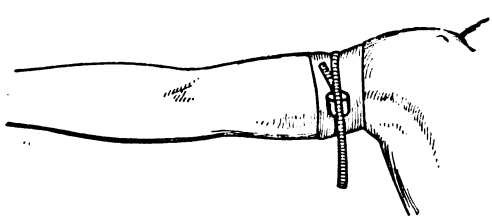

FIG. 27.

pressure then controls the artery against the humerus. A tourniquet is easily applied here.

Bleeding from the *Palm* is best controlled by a graduated compress, the fist is then clenched over a roller bandage which presses on the compress and the fist is then bandaged in the clenched position.

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The Lower Extremity.—*The Femoral Artery* is best controlled by feeling for the vessel just below the inguinal ligament and pressing backwards against the pubis. The artery lies midway between the anterior spine of the ilium and the symphysis pubis. With the patient on the ground, the pressure is best made by some one who is kneeling on the opposite

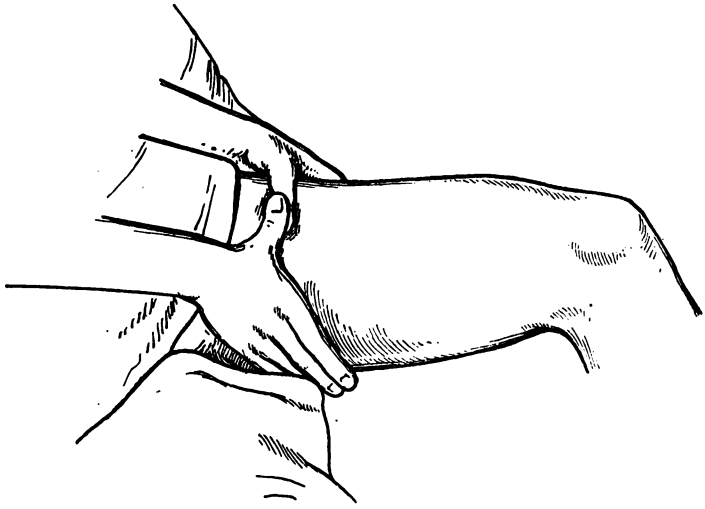

FIG. 28.

side of the patient, as he will then not be in the way of the one dealing with the wound.

A tourniquet should be applied with the pad on the inner side, half-way down the thigh.

Head and Neck.—*The Common Carotid* can be compressed by the fingers pressing the sides of the neck backwards and inwards against the transverse processes of the vertebræ, of which that of the sixth cervical is the most prominent.

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The External Maxillary Artery can be felt beating as it passes over the lower jaw, it can easily be controlled at this point.

The Temporal Artery can be felt beating as it passes over the prominent piece of bone immediately in front of the upper part of the ear.

Bleeding from the *Nose* apart from fractures of the nasal bones nearly always comes from the front part of the organ. It can therefore usually be controlled by pinching this part of the nose. At the same time the patient should be sat upright and cold applied to the face and neck, while warmth is applied to the abdomen or the feet placed in hot water. Should the patient feel faint he must lie down on his side. Only rarely does the surgeon require to plug the nostrils. Straining, coughing and blowing the nose should be avoided.

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CHAPTER VIII

THE RESPIRATORY SYSTEM AND VENTILATION

Anatomy and Physiology

THE organs by which air is conducted in and out of the body are known as the respiratory tract.

The Mouth and Pharynx are described with the

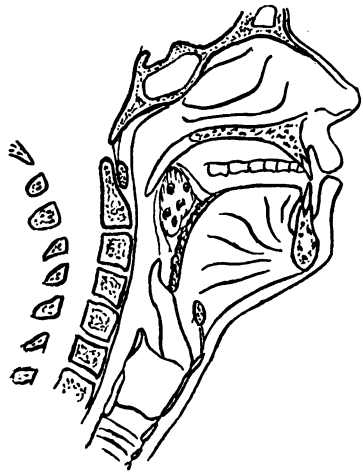

FIG. 29.

alimentary system. The mouth should not be used for breathing except when talking, singing and in certain special conditions as when out of breath. The nose is the proper inlet and outlet for air.

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The Nose is a double passage leading from the face to the pharynx, and the two sides are separated by a medium partition, and both are separated from the mouth by the hard and soft palate. From the outer walls small ridges project so that the extent of the mucous membrane is very large indeed. It is further increased by cavities in the bones of the face which open out of the nose. This increase in the extent of the mucous membrane is to enable the air taken in to be warmed and moïstened before it enters the larynx.

The Larynx, or voice box, opens out the pharynx just below the epiglottis at the back of the tongue. The opening is very narrow and during swallowing it is completely closed. The larynx can easily be felt at the top of the neck, where it causes the projection known as Adam's apple. In the interior are placed the two vocal folds which are thin bands of elastic-like tissue, which can be tightened or relaxed at will. When air is taken in the folds separate to allow a free entry, but during expiration they lie close together so that the air plays over their edges which are thrown into vibration in talking and singing, the different sounds and modulations of the voice being produced by varying the position of the tongue, soft palate and lips. Below, the larynx is continuous with the upper end of the trachea.

The Trachea or windpipe is a tube about four and a half inches long, about half can be felt in the neck and the other half lies in the upper part of the chest. The sides of the tube are prevented from coming together by horseshoe-shaped pieces of cartilage which can be felt below the larynx.

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At its lower end, the trachea divides into two bronchi, one bronchus passing to each lung.

The Bronchi are named right and left, and are short tubes which begin to divide as soon as they reach the lungs. They divide into smaller and smaller branches leading all through the lung

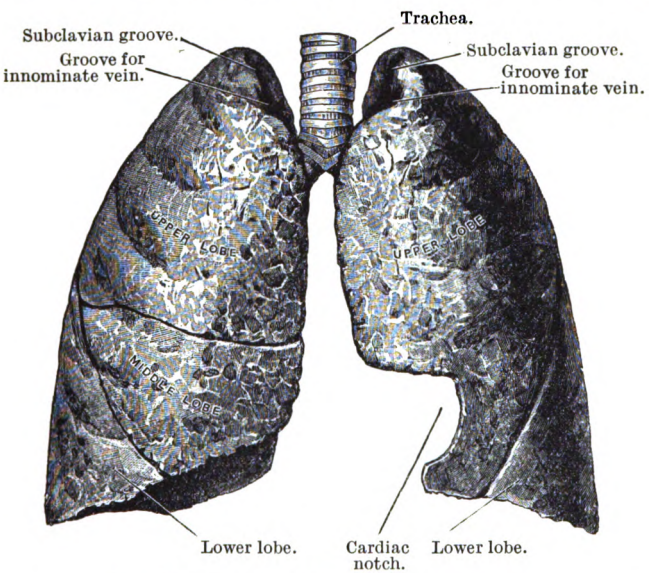

FIG. 30.—The Trachea, Bronchi, and Lungs.

tissues, the smaller tubes being called bronchioles. Their walls are stiffened to keep them open by small pieces of cartilage. The smallest bronchioles end in clusters of air sacs closely packed together and separated from each other by very thin walls.

The Lungs and Pleura.—The lungs are two in number, right and left, situated in the chest with the heart between them. They are made up of the

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divisions and subdivisions of the bronchi and pulmonary vessels, and of innumerable air cells, the whole being bound together by a small amount of tissue of a highly elastic nature. The surface of each lung and the inner surface of the chest wall are covered by a smooth shining membrane called the pleura. Each lung, therefore, lies in a sac of pleura, the two sacs being quite separate from each

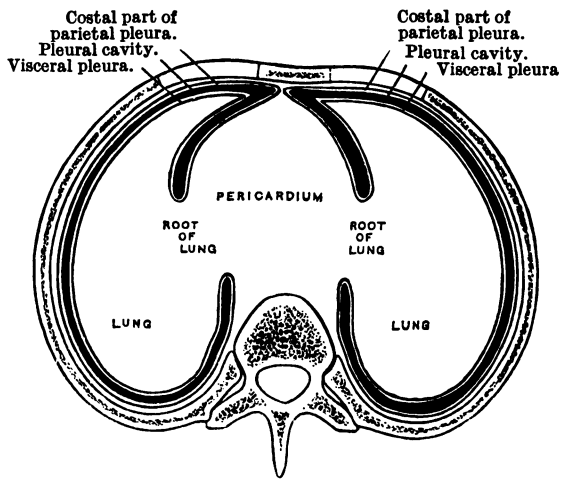

FIG. 31.—Diagram showing Arrangement of Pleural Sacs as seen in Transverse Section.

other. The pleura covering the lung and that covering the inner surface of the chest wall lie in contact with each other, but are not attached in any way, the smoothness of their surfaces allowing free movement as the chest moves. The surfaces are only kept in contact by the air pressure in the lung. If a hole were made in the chest wall, the air would enter the pleural cavity, as the elasticity of the lung would make it contract, and leave

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a considerable space between the two pleural surfaces.

The Pulmonary Vessels are arranged as follows. The pulmonary artery carries the impure blood from the right ventricle and divides into two branches, one going to each lung. The arteries divide with the division of the bronchi into smaller and smaller branches, the smallest end in capillaries between the air sacs, so that the blood is only separated from the air in the sacs by one delicate layer of cells. This allows a free exchange of gases to take place between the air and the blood. The blood passes from the capillaries into veins, which join together and pass out of the lungs as the pulmonary veins, they convey the blood to the left auricle.

The Mechanism of Respiration

To make air enter it is necessary to enlarge the capacity of the chest, to drive it out again the capacity must be diminished. The alteration in the capacity of the chest goes on continually and is known as respiration; it is produced as follows—

Inspiration or drawing air in is the result of increasing the diameters of the chest in all three directions. Each rib is joined to the one above by muscles, these when they contract will lift up the front end of the rib together with the sternum. The first rib is fixed by muscles of the neck. When the muscles contract the upper one is lifted slightly and the others are all drawn upwards, the movement increasing as we pass down. As the ribs slant downwards and forwards, lifting them up makes them more horizontal and therefore increases the distance between the sternum and the spine. On

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lifting up the ribs, their curved shape will make the chest expand in a lateral direction as well. The depth of the chest is greatly increased by the contraction of the diaphragm which pushes down the liver and abdominal viscera, causing the abdominal muscles to protrude to accommodate them.

Expiration, or the driving out of the air, is much simpler, as it is brought about by relaxation of the muscles, this allows the ribs to fall back in their former position in response to gravity. On relaxation of the diaphragm, the tension of the abdominal muscles forces back the viscera and causes the diaphragm to rise.

The Chemistry of Respiration

The intake of oxygen to the lungs is the beginning, and the output of carbon dioxide from those organs is the end, of the series of changes which take place during respiration. The intermediate stages in the process take place in the tissues all over the body.

The atmospheric air consists very largely of two gases with a third in very small quantity, its temperature and the amount of moisture it contains vary with the seasons.

	Inspired Air.	*Expired Air.*
Oxygen . . .	20 vols. per cent.	16·5
Nitrogen . . .	79 ,, ,,	79
Carbon dioxide . .	·04 ,, ,,	4·5
Watery vapour . .	varies	saturated
Temperature . .	,,	98·4

Oxygen (O_2) is the most important gas, it passes into the air sacs, and there the blood takes up as much oxygen as it can carry, and bears it away to the tissues throughout the body. The tissues, especially the muscles, use it to burn up the food

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substances to perform muscular work, giving back the products of combustion in the form of carbon dioxide. The oxygenated red arterial blood has the oxygen removed from it in the capillaries, and returns as dark venous blood loaded with carbon dioxide (CO_2) to the lungs, where it gives up its carbon dioxide to the air and receives again another supply of oxygen. The nitrogen is an inert gas and passes in and out unaltered. The watery vapour can be seen condensing in a cloud of steam on a cold day, but can always be demonstrated by breathing on cold glass or metal surface, on which it condenses. The importance of the temperature of the air breathed out is dealt with under the heading of " Temperature."

Ventilation

It has been calculated that an adult man in ordinary work gives off in twenty-four hours twelve to sixteen cubic feet of carbon dioxide from his lungs besides a certain quantity from his skin. The amount of watery vapour from the lungs and skin is estimated at thirty ounces per diem. The air of a room in which people are present becomes rapidly changed, the oxygen being used up and the CO_2 and the moisture greatly increased in quantity. Besides this other factors come into play, the movement stirs up into the air vast quantities of dust and bacteria which has settled upon the floor, chair, curtains, etc., and these remain suspended for some time. In the evening when artificial lights have to be used, such as candles, lamps or gas, a large quantity of oxygen is used in them and much additional carbon dioxide given out to the air. Taking these

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things into account, 3000 feet of air per head per hour, that is to say, if a person had 3000 cubic feet of air space, the air should be changed once during the hour, if he had only 1000 cubic feet air space allowed him the air will need changing three times during the hour. If the air has to be changed quickly a draught will be caused and this must be avoided. The fresh air must be diffused through the room; in no part ought it to remain stagnant. A means of entrance must be provided for the fresh air and an exit for the foul.

The air that has been used and is therefore foul has been heated by the body and therefore expands and becomes lighter and rises to the top of the room and will escape by any aperture such as the top of an open window; if this happens, then fresh, cold air must come in to take its place, and this will enter by the chinks round the lower part of the window and door or down the chimney when there is no fire burning. If there is a fire burning the hot air rushes up the chimney and draws cold air into the room through other channels. It is best to mix the heated air with the cold air, so that the temperature is kept more equal and the exchange of air goes on gradually without a draught. The simplest way of ventilating a room without causing a draught is to raise the lower sash and place across the width of the window a piece of wood some six inches deep; the lower sash is then closed down upon this. An air space is now left between the two sashes in the middle of the window. The cold air entering instead of falling at once to the floor is given an upward direction and diffuses gradually through the room.

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CHAPTER IX

DISEASES OF THE RESPIRATORY SYSTEM

A Cough is a violent explosive expiration, in which the muscles of the chest and abdomen contract to drive out the air, but the muscles of the larynx keep the vocal folds tight shut until the pressure rises to a sufficient height, when the folds are suddenly relaxed and the air escapes with enough force to cause a noise, and at the same time expel any irritating substance, such as a crumb or mucus, which may be present. On account of the violent contraction of the muscles necessary in coughing, the act is very exhausting if continued for more than a few minutes. As the tension is very great the voice often suffers and becomes hoarse. The character of the cough varies with the cause.

In Bronchitis it is due to the presence of so much mucus and may be accompanied by wheezing, rattling or bubbling sounds in the chest.

In Laryngeal disease the cough loses its tone and becomes hoarse or whistling, and in severe cases may almost be noiseless.

In Pleurisy the cough is short and sharp and evidently accompanied by pain.

In Whooping Cough it is paroxysmal and grouped. (See *Whooping Cough.*)

In *Aneurism of the Aorta* it may be clanging and metallic in sound.

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Breathing.—The average number of respirations a minute is thirteen to seventeen for an adult, more for a child, and about twenty-five for a baby. The number and character of the respirations may alter considerably and may be accompanied with noise. Dyspnœa is a term signifying difficult respiration.

In Laryngeal affections the respirations are rapid and may be crowing or whistling, as in diphtheria, in which case the movements of the chest should be looked at to see if there is great difficulty in drawing in air. If difficulty is present, the muscles are seen working vigorously, and the lower ribs are pulled in by the diaphragm instead of being expanded, the tissues also at the root of the neck are sucked in.

In Bronchitis and Asthma, bubbling, rattling, wheezing or cooing sounds may be heard.

In Pleurisy the breathing is very shallow and sudden, and resembles a series of small, quickly given grunts.

Snoring may be present during sleep from the vibrations of the soft palate against the back of the pharynx and is very loud in abscess of the back of the throat, and where the pharynx is partly blocked by adenoids; if the child is snoring from these causes the noise will stop on turning the child on its face.

Stertorous Breathing is another form of snoring, due to paralysis of the palate, and is heard after injuries to the head, where there is complete unconsciousness with some compression of the brain. The loud noise is made by the flapping palate during inspiration, while in expiration the flaccid and

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paralysed cheeks and lips are blown out by the air.

In *some Cerebral Affections* and forms of coma the breathing becomes grouped or wave-like, small respirations gradually increase in depth and then fade away, in all, perhaps, ten to twenty respirations being taken, followed by a long pause, and then the cycle begins again. This is termed " Cheyne Stokes' Breathing."

The Common Diseases of the Respiratory Tract are a cold, laryngitis, bronchitis, pneumonia, pleurisy, asthma and phthisis.

A Cold in the Head is an inflammatory affection of the mucous membrane of the nose and throat.

Catarrh is the name given to inflammation of mucous membrane. The vessels become enlarged, there is swelling from exudation into the mucous membrane, and great increase in the amount of the secretion. The epithelial cells proliferate and are shed. The condition is obviously infective.

In the early stages the mucous membrane of the nostrils is reddened and swollen so that breathing is difficult. The irritation causes sneezing, which is an attempt to clear the passages. The increased secretion is quite clear. After twenty-four to forty-eight hours the secretion is thicker and becomes muco-pus, from the shedding off of the cells from the mucous membrane. After a few days the whole thing clears up if a little care is taken. The catarrhal process is liable to spread down through the larynx to the trachea and bronchi and set up laryngitis and bronchitis. A delicate person should remember this and not neglect ordinary precautions.

Laryngitis is catarrh or inflammation of the

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larynx, and may be the result of exposure to cold, over use of the larynx as in speaking or preaching, or to an irritant, it may also be the sequel to a cold in the head. Certain very severe forms may be due to other diseases such as tuberculosis, syphilis or cancer. The diphtheritic form is dealt with elsewhere.

Symptoms are a feeling of rawness in the throat, especially on breathing, a liability to cough, slight feverishness and a hoarseness of the voice. If there is no obstruction as in the ordinary catarrhal form there is no dyspnœa.

Management.—The patient should be confined to one room, and if necessary put to bed. The temperature of the room should be about 65° F., and the air moistened by allowing the steam from a kettle to escape into the room. Medicated inhalations are very comforting. In the mild cases the laryngitis will clear up in a day or two. Where there is dyspnœa and obstruction, as in swelling of the back of the throat from any cause—swallowing hot or irritating fluids, stings of a wasp, diphtheria, or acute Bright's disease, the amount of distress must be carefully gauged and watched so that any increase may be noted and reported at once.

Obstruction to respiration is always more serious in children than in adults and has to be dealt with in time. As soon as tracheotomy is necessary, delay is fraught with danger. (See *Tracheotomy.*)

Bronchitis is the inflammation of the mucous membrane of the trachea and bronchial tubes. It is either the result of a chill, breathing cold air, irritating fumes, or, as very frequently happens, the spread of the catarrh down from a cold in the head. In the last instance the simple mild form of bronchitis

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is treated as part of the after-effects of a cold. The severer forms may be either acute or chronic.

1. *Acute Bronchitis* is a very severe affection both in old people and in children, and requires careful management.

Symptoms.—Dyspnœa with a raw feeling in the chest on inspiration which causes coughing, while during expiration wheezing sounds are heard, and bubbling is felt which sets up a tickling sensation and induces cough. During the early stages the coughing brings up a considerable amount of frothy, watery expectoration, later on this becomes thicker, more tenacious and greenish-yellow — muco-pus, which adheres to the sides of the cup.

The majority of people recover in four to six weeks and are then all the better for a change of air to a sheltered, warm climate during the cold months, or to the seaside during the warm ones. When the inflammatory changes spread to the smallest tubes and through them actually to the alveoli of the lungs, as sometimes happens in children, the condition is called broncho-pneumonia, as in addition to the bronchial changes there are small patches of pneumonia scattered about the lungs. This condition is often fatal in children, especially when it follows other diseases, such as measles or whooping-cough, or occurs during rickets.

2. *Chronic Bronchitis* has symptoms very similar but less striking than the acute form, and is a very constant affection among old people during the winter months—hence the name of winter cough. The coughing, though not very marked, produce after some time far-reaching changes, such as emphysema or distension of some of the alveoli,

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asthma, and obstruction to the circulation, and therefore some weakness of the heart.

Management of Bronchitis.—The patient should be kept in bed, in a room where the temperature is kept constant at about 65°. It is a great comfort to the patient if the air is moistened by means of a bronchitis kettle. Ample ventilation should be allowed so that the air is fresh, but draughts must be avoided.

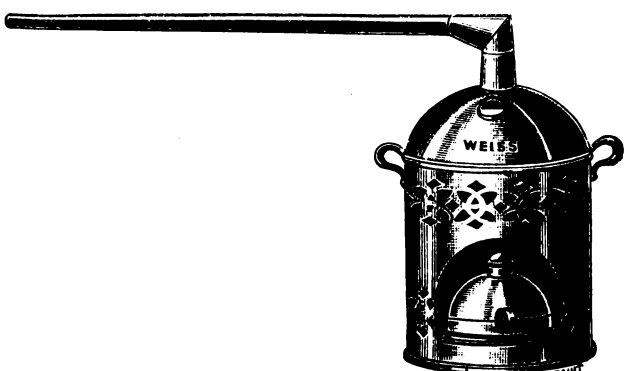

FIG. 32.—Bronchitis Kettle.

The patient should be warmly clad about the neck and shoulders, as the most comfortable position if there is dyspnœa is the semi-recumbent with the shoulders propped up by pillows, and therefore the bedclothes are of little use to the upper part of the body.

A pneumonia jacket (see *Pneumonia*) can be usefully applied. Old people sometimes prefer to sit upright. Young children always swallow their sputum, but for those old enough, a sputum cup should be provided and the quantity and nature of

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the expectoration noted. The amount of dyspnœa can be gauged by the number of respirations a minute, and the appearance and amount of lividity of the lips, ears and face.

The patient should be encouraged to take plenty of light fluid nourishment, stimulants are most useful, especially in the old and feeble. The remedies applied are often very much in the nurse's hands, viz. liniments to the chest, of which turpentine liniment is perhaps the favourite, inhalations and poultices. The drugs given differ in the early and late stages of the disease. In the early stages they are given with a view rather to check the excessive secretion, while in the later stage they are given to loosen the viscid muco-pus. Sometimes cardiac tonics are necessary.

During convalescence the patient must avoid draughts and sudden changes of temperature which are liable to produce chill.

Asthma.—Asthma is an affection of respiration which comes on in attacks. It is often associated with chronic bronchitis, but may affect people quite apart from this, the attacks coming on for no apparent cause. The phenomena seen are supposed to be due to spasm of the muscles which surround the small bronchi.

Symptoms.—Night and early morning are the usual times for an attack. In a typical attack there is a feeling of tightness in the chest, the patient sits in bed with the knees drawn up, he takes a long inspiration, at the end of which the chest seems to remain expanded, and expiration can only be brought about with difficulty. As the chest is already expanded he cannot take in any more air and gasps

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helplessly for breath, so that he seems in imminent danger of suffocation. Expiration when it does occur is only partial and is accompanied by a wheezing sound. Gradually the attack passes off and as a rule coughing takes place, though at first the coughs are very feeble from the inability to contract the chest. As the cough gets freer some frothy sputum is brought up.

Management.—The attacks though alarming are seldom dangerous, and the patient can be assured that the attack will soon pass off. A great many remedies are used in the hope of preventing or cutting short the spasms, and every patient subject to asthma will have tried the many methods recommended till he has found the one he thinks suits him best. Amyl nitrite, fumes of burnt nitrate papers, or patent powders, are used as inhalations, strong coffee and injections of morphia are also useful. Various cigarettes containing antispasmodic drugs are smoked and the fumes inhaled to stave off the attacks. In those liable to the disease, errors in diet or certain foods or smells are well known to bring on the attacks. Some people cannot stand the atmosphere of certain localities, and have to move in consequence. Curiously enough the soot-laden atmospheres of our large towns seem to suit these people better than the purer air of the country.

Pneumonia is the inflammation of the tissues forming the air sacs of the lungs, and like bronchitis may be brought on by chills and exposure, or else by spread of catarrh down the bronchi, breathing irritating fumes, or by foreign substances, which by mistake may get sucked into the trachea. Pneumonia is also a common complication of many

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diseases such as typhoid fever, acute rheumatism and heart disease. A low form of pneumonia is easily set up in old people who are confined to bed, and in whom the circulation is weak.

Pathology.—As a result of the inflammation, the walls of the alveoli swell, the vessels are engorged so that the alveoli become smaller. The cells lining the alveoli proliferate and are shed as in an ordinary catarrh, the exudation of inflammatory lymph takes place not only into the tissues, but also into the air cells. The lymph coagulates and the whole lung or part of a lung becomes solid, so that no air can get into the air cells, and that part becomes useless as far as the æration of the blood is concerned.

Whole lobes of the lung are usually affected, sometimes the whole lung solidifies, while in double pneumonia both lungs are affected to a greater or less extent. The greater the area of lung affected, the more serious the disease becomes.

Symptoms.—The disease may come on with great suddenness or after a day or two of slight premonitory illness. The invasion is characterised by chilliness and fever, sometimes by one or more rigors, vomiting is not unusual. Next day the pulse is rapid, the temperature about 103–104°, and as a rule the respirations are increased and accompanied by a cough and pain in one side of the chest. In the course of two or three days from the start the patient will have assumed the typical aspect of one suffering from pneumonia. The cheeks are flushed but dusky, the nostrils dilate at each inspiration, the breathing is rapid, sudden, shallow, and sometimes grunting, there is often a patch of herpes round the mouth. The pulse and respira-

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tions are rapid, but while the normal ratio between the two is about 4 to 1 (pulse 70, respiration 17) the ratio is now altered. the pulse may be 110 to 120 and the respirations 40 to 60, the ratio now being 3 to 1 or even 2 to 1. The more the ratio is altered the worse is the outlook. The temperature goes up to 103–104° F., and remains steady at that height for seven or eight days, at the end of which time it drops down by crisis, there is profuse perspiration and the exhausted person passes into peaceful sleep. In the early stages the cough only brings up a very viscid and tenacious white expectoration, which is difficult to get rid of, and has to be wiped from the lips, sometimes it is tinged with blood. In the later stages the contents of the solid parts of the lungs liquefy and come away. There is then a copious expectoration of this material, which comes up reddish-brown or the colour of prune juice, this gradually gets less as the lungs return to normal.

The skin is dry and the secretion of urine scanty till the crisis is passed, after which the skin perspires and the kidneys act more freely.

The nervous symptoms are often marked by delirium at night, restlessness and sleeplessness. Pneumonia is a very fatal disease especially in the aged, the drunkard, and those whose constitution is undermined from any cause. The cause of death is usually either dilatation of the heart and heart failure, from the difficulty of driving blood through the solid lung, or due to exhaustion, or asphyxia, from too great an area of the lungs being involved.

Management.—Nursing is of great importance in this disease. The patient is put to bed at once in a well-ventilated, airy, and warm room. The pulse,

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temperature and respirations are carefully noted on a chart, a daily or a four-hourly one being kept.

The character of the breathing, the presence of the pain and cough reported, and any expectoration kept for inspection. A pneumonia jacket of cotton wadding should be made to cover the back and front of the chest. Hot turpentine stupes, or mustard poultices can be used to alleviate the pain, some, however, get more ease from the application of an ice-bag. The patient should be encouraged to take light nourishment to maintain his strength, while the amount of sleep should be carefully noted and reported, as hypnotics may be necessary to prevent exhaustion. With a temperature remaining steadily elevated, the patient loses strength rapidly, and anxiety increases as the crisis approaches. Brandy and strychnine are used freely to maintain the flagging heart till the temperature falls. The danger is not over till some two or three days after the crisis has occurred.

Should the person be very feeble it is as well to nurse them on a water-bed. In those who drink alcohol freely though not drunkards, delirium tremens is very common, and the nurse should recognise it at once and report to the doctor. Those who indulge in alcohol to greater extent may exhibit violent mania during the night hours, and help may be required to control them. Every effort should be made to get these patients to take nourishment, as their restless condition rapidly brings on exhaustion. Large doses of sedatives may be needed.

Pleurisy is the inflammation of the pleura or membrane which covers the lungs, and also lines

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the inner aspects of the chest wall. The membrane is thin and smooth and secretes a small amount of fluid so that the lungs can expand freely during enlargement of the chest. Pleurisy always accompanies pneumonia, but it may be caused apart from this by cold and exposure, or from injury to the chest wall as in fracture of the ribs. It may also complicate other diseases, but is especially liable to occur in those who are prone to become phthisical.

Symptoms.—Pleurisy has two stages, the first being the stage of dry pleurisy, the second being the stage of pleurisy with effusion.

Dry Pleurisy.—As the result of the inflammation the glistening smooth membrane is roughed and a stabbing pain is felt each time the two rough surfaces move the one on the other. The respirations are quickened, but are made as short and as sudden as possible, and the cough is of the same character. The patient endeavours to breathe as far as possible only with the sound side of the chest, and for this reason often lies upon the affected side. Many of the slighter cases of pleurisy never extend beyond this stage, and recover without any effusion taking place.

Pleurisy with Effusion is the second stage and only develops in the severer cases. Here the inflamed and roughened surfaces pour out such a quantity of fluid that the lung and chest wall are separated by the effusion. As the fluid increases in quantity the lung is compressed and rendered useless for breathing. If the fluid still increases in quantity the other viscera are displaced, the heart is pushed over to the opposite side, and the diaphragm and liver pushed downwards. The symptoms of effusion

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appear insidiously, the pain disappears as the rough surfaces no longer touch, and the breathing loses its sudden jerky character, but as the effusion becomes more and more established, the breathing is more rapid, as only one lung can act, and signs of cyanosis appear. The temperature as a rule remains up. The pulse gets more rapid as the heart is acting under difficulty, being pushed over by the fluid. One of the chief dangers is heart failure.

Management.—The patient should be kept warm in bed and every effort made to curtail the affection during the dry stage. Turpentine stupes, mustard poultices, iodine or strapping are applied to the side of the chest. Internally salicylates and iodides are often given. The diet should, of course, be light and the bowels freely opened. When the effusion has appeared, no exertion of any kind should be allowed, as faintness may come on. Counter irritants may still be applied to the chest to promote absorption of the fluid, and mild sweating and purging encouraged. In many cases the effusion gradually subsides; if, however, there is dyspnœa or the heart is displaced and the pulse is weak, it is better to draw off some or all of the fluid by aspiration or tapping the chest.

Aspiration is performed by introducing a sterile hollow needle into the pleural cavity and allowing the fluid to run out through it. Tapping the chest is not such a simple matter as tapping the abdomen, as the movements of the chest tend to draw air in through the needle in the same way as air is drawn in through the trachea, it is necessary, therefore, to use an apparatus which will prevent this. For this purpose a tube fitted with a tap is attached to the

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needle and leads to a large glass bottle from which the air has already been exhausted by means of an air pump. When the tap is turned, the fluid will be drawn from the chest into the bottle, and no air can pass in the opposite direction. When the bottle is full, the tap is turned off and the bottle emptied, the cork reinserted, and the air exhausted as before; the tap can then be turned on and the remainder of the fluid removed. The nurse should have ready some iodine to disinfect the skin, and some gauze and collodion, or strapping, to seal up the puncture hole. The process of aspiration may have to be repeated before the condition clears up completely. The fluid drawn off is pale straw colour with a greenish tinge, in which flakes of lymph are sometimes seen. Sometimes the fluid drawn off proves to be pus in which case there is said to be an empyema.

Empyema is the term used to denote pus in the pleural cavity. Pleural effusions often turn into pus in children or young people, especially when the pleurisy is the result of pneumonia, or has arisen in the course of another disease, such as scarlet fever or typhoid. It may also arise as the result of septic wounds of the chest involving the pleural cavity, or in the course of a pyæmic case.

Symptoms.—When an effusion becomes pus, other symptoms are superimposed on those caused by the mere presence of fluid. The temperature is more irregular and swings to a higher level, the pulse is more rapid, there is profuse sweating at night, and the emaciation is greater.

Management.—The treatment in empyema should be prompt. When fluid is known or suspected and the

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symptoms severe, the chest is usually explored—that is, a hypodermic needle is inserted to draw off some fluid so that its presence and nature may be ascertained. When pus is present it is necessary for the surgeon to open and drain the pleural cavity. This he does by excising a piece of rib through an incision in the side, the patient being under an anæsthetic. Several dishes should be to hand to catch the pus as it flows from the wound. Some of the pus withdrawn should be saved by the nurse for bacteriological examination. A drainage tube is then inserted and fixed in position by a stitch or a safety-pin, so that it does not slip into the pleural cavity. A liberal supply of gauze and wool should be applied as a dressing, and this will have to be changed in a few hours, as the flow of pus is very copious at first and will soak through the dressing. In changing the dressing, the tube should not be disturbed without orders from the doctor, as at first it may not be easy to reinsert, later on, when the wound is partly healed, this difficulty is not met with. If after removing the dressings at any time the tube has slipped out of the wound, it will usually be found on the surface of the dressings, and should be disinfected before it is reinserted. If the tube is not found, the dressings must be carefully searched, the person who last dressed the wound must be questioned to find if the tube was put back; if it cannot be accounted for, a report should be made to the doctor at once, as the tube will probably have slipped into the chest, and if sought *immediately* may be recovered by a pair of forceps just inside the wound. After the pus has been let out, the temperature begins to subside and

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the patient improves visibly, a fresh rise of temperature usually means that there is some obstruction to the outflow of pus, large solid flakes of lymph may be the cause of the obstruction, and require the use of forceps to remove them. An empyema wound should not be washed out, as sudden death from shock may result. The discharge usually ceases in a few weeks and the wound heals up completely. If the discharge goes on for a long time in a growing child, considerable deformity of the chest may result, and sometimes curvature of the spine is thus caused.

Pulmonary Tuberculosis. — Phthisis or consumption, as it is popularly termed, is a disease which carries off a larger number of the population yearly than any other disease. Tuberculosis of the lungs is infectious, and those living in too close contact with patients suffering from this disease are liable to become infected. In most cases the tubercle bacillus gains access to the lungs by the air we breathe. In the lungs it sets up a process of ulceration and destruction of the lung tissues, which break down so that cavities are formed. Hæmorrhage may take place from the ulcerated surfaces, and a variable amount of blood may be coughed or spat up constituting hæmoptysis. The infected blood and sputa may be aspirated into other parts of the lungs and so spread the disease. The infection is more liable to occur in those people who suffer from privation, and live in damp and badly ventilated buildings, while overwork, long hours of indoor employment, and excesses of all kinds, must also be considered as exciting causes. Heredity is said to play an important part in determining the disease,

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but beyond coming of a weakly stock, heredity is not so important to the individual as environment and exposure to infection, as, for instance, living with relations who already suffer from active phthisis.

The course the disease pursues differs in individuals according to the amount of resistance the system offers to the disease.

Clinical History.—Many cases begin with cough and expectoration of muco-pus, which is thought to be the result of some chill or exposure. Others begin by bringing up blood. Occasionally pleurisy draws attention first to the lungs, while sometimes loss of weight may give the alarm. The disease often follows other prolonged diseases. The symptoms are cough, dyspnœa, purulent expectoration, hæmoptysis, sweating at night, emaciation and hectic fever.

Treatment.—The patient should be put to bed if the temperature is at all raised and should be kept absolutely at rest. This in itself will often lower the temperature. Good food should be given and every endeavour made to fatten the patient without upsetting his digestion.

The windows should be open day and night. There should be at hand a bottle or sputum cup which contains some antiseptic solution and all secretion brought up from the lungs should be expectorated into this receptacle and not swallowed. Spitting spreads the disease, as the organisms dry and are carried on particles of dust which are breathed in by other people.

The organisms in the lung tissues may be attacked in many ways, but chiefly by increasing the health

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of the patient and so raising his resistance to the bacillus. Other methods are useful, such as a course of injection of tuberculin, or better still contra-toxin; or continual saturation of the air breathed into the lungs with an antiseptic may be tried, the patient wearing over his nose a mask containing some cotton wool on which are sprinkled a few drops of a volatile oil such as eucalyptus.

As long as there is a rise of temperature the patient should be kept absolutely quiet in bed, after the temperature has been normal for some time a slight amount of exertion should be allowed, such as sitting up in bed, later if all goes well he may be allowed up on a sofa or easy-chair for some hours a day, the time being gradually increased. Later still light exercise carefully regulated is given and gradually increased until a full day's work may be performed without any rise of temperature. Any rise of temperature requires that the patient's exercise should be cut down at once and the process must begin again. The weight is kept charted each week.

Under this method of treatment a very large number of cases recover; in some, however, the system seems unable to cope with the disease and the person gradually wastes and becomes weaker until finally overpowered.

The disease is as a rule slow, most cases taking at least a year to recover, and the fatal cases last as a rule two or more years. Some fatal cases, however, run their course with great rapidity in six to eight months or even less; this is sometimes termed galloping consumption.

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CHAPTER X

THE DIGESTIVE SYSTEM

The Anatomy of the Organs of Digestion

THE long tube-like structure in which food is received, digested and absorbed, is termed the alimentary canal; it consists of several distinct parts, as follows: the mouth, pharynx, œsophagus or gullet, stomach, intestines.

Opening into it are numerous glands, which pour in their juices and bring about digestion of the food as it passes along. Some glands, like the gastric and intestinal glands, are situated in the mucous membrane of the canal, others like the salivary glands, liver and pancreas, are situated at a distance, and pour in their secretion by means of ducts.

The Mouth should be inspected and the main points identified. The teeth are counted from the middle line, and in a child in each jaw are two incisors, one canine and two premolars or bicuspids, making twenty in all; in the adult there are added to these, three molars, making thirty-two in all. The first permanent tooth to appear is the first molar about the age of six years, the third and last molar not till seventeen to twenty-five years old, and may never erupt for want of room.

The Tongue is a movable muscle which lies on the floor of the mouth, its surface is roughened by

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numberless papillæ, some at the back being of large size. In the middle line under the tip is a fold

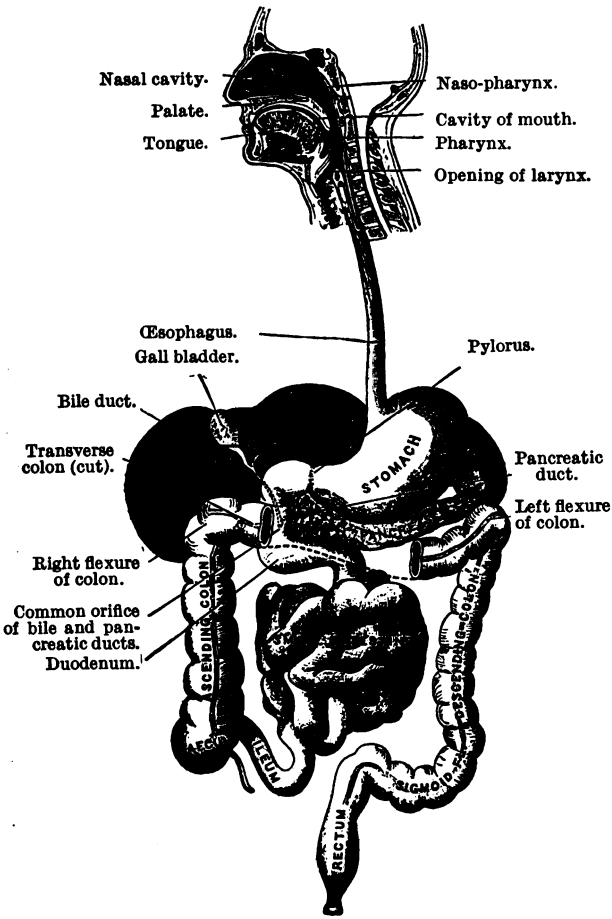

FIG. 33.—General View of the Digestive System (diagrammatic).

called the frænum. When this fold is too short to allow the tongue to be protruded beyond the teeth

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the condition is called tongue-tie. On each side of the frænum are the small openings of the sublingual and submaxillary ducts, the glands being situated in the floor of the mouth. If the cheek is held away from the teeth a small projection will be seen opposite the first molar of the upper jaw, this is the opening of the parotid duct, the parotid gland itself lying in front of the ear. The gland becomes swollen and painful in mumps.

The Hard Palate is the bony wall which separates the compartments of the nose and mouth in front; the soft palate continues this behind, and being freely movable is able to shut off the nose at will as in blowing hard, or in swallowing. *The Uvula* hangs from the back of the soft palate.

The Pharynx is the space between the back of the mouth and the œsophagus. The two pillars of the fauces pass down from each side of the palate. Between the pillars are situated the tonsils, which are masses of lymph tissue and mucous glands. The posterior nares are the openings at the back of the nose above the soft palate. At the very back of the tongue is a leaf-like projection, the epiglottis, immediately below this is the glottis or opening of the respiratory tract. Muscular folds covered by mucous membrane pass from each side of the epiglottis to surround the glottis. When they contract, the opening into the respiratory tract is completely closed. This happens in swallowing, the epiglottis does not shut down over the opening like a lid.

The Œsophagus or **Gullet** is a narrow muscular tube nine to ten inches long, extending from the pharynx to the cardiac end of the stomach. In the

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neck it lies just behind the trachea or windpipe a little to the left of the middle line. In the thorax it passes behind the left bronchus and the heart, but is in front of the aorta; it pierces the diaphragm to enter the abdomen and joins the stomach.

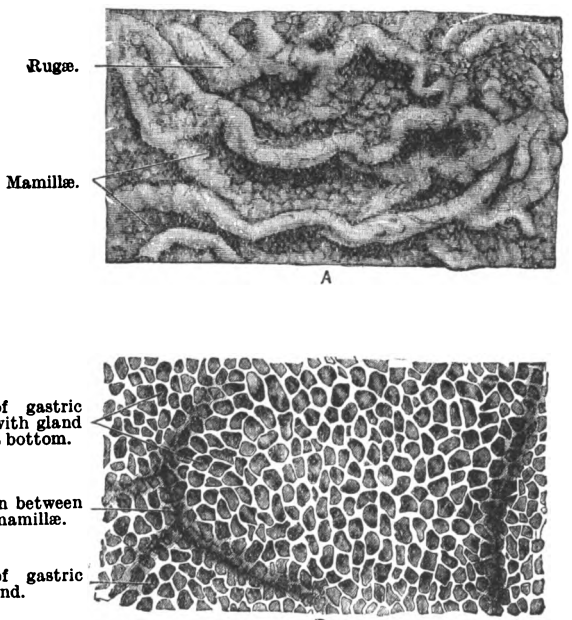

FIG. 34.—Mucous Membrane of the stomach.
A. Natural size.
B. Magnified 25 diameters.

The Stomach is a bag-like organ varying in shape and size with its degree of distension. It has two orifices, the cardiac orifice, where the œsophagus joins it, and the pylorus, where the small intestine begins.

The Walls of the Stomach and Intestines are formed in very much the same manner. Each

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has (1) a peritoneal coat formed by the peritoneum; (2) a muscular coat which has the general arrangement of two layers, in the outer one the fibres run longitudinally, in the inner they run transversely and surround the lumen; (3) internal to the muscular

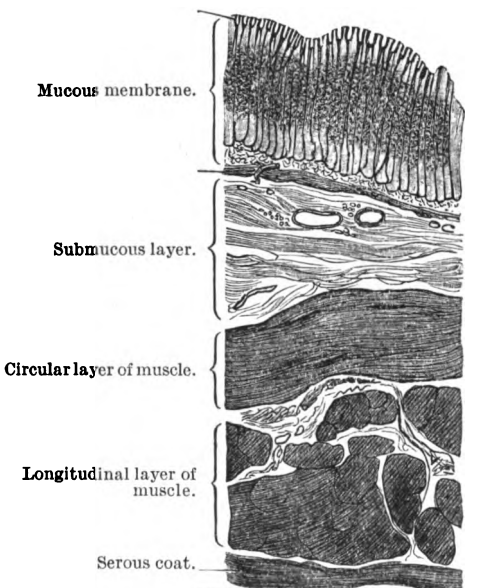

FIG. 35.—Transverse section through the wall of a human stomach × 250.

layer there is a mucous membrane set upon a varying amount of loose areolar or submucous tissue in which the blood-vessels, nerves and glands of the mucous membrane all lie. The mucous membrane of the stomach, if looked at with a lens, presents a honeycomb-like appearance, from the openings on its surface of countless small tube-like

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glands. These glands secrete the gastric juice, the action of which will be noted later.

The Intestines are about thirty feet in length, and are divided into two chief portions, called from their differences in diameter, the small and large intestine.

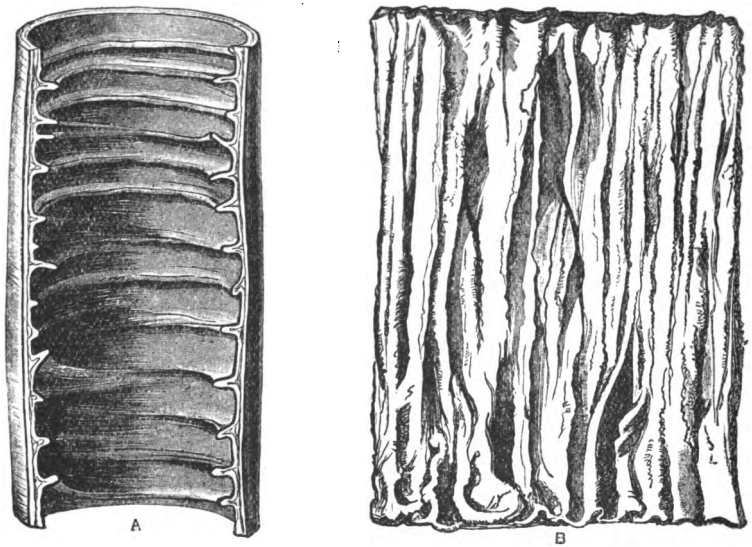

FIG. 36.—Circular Folds (natural size).

A. As seen in a portion of jejunum which has been filled with alcohol and hardened.
B. Position of fresh intestine spread out under water.

The Small Intestine is divided into three portions, the duodenum, the jejunum and the ileum.

The Duodenum is the first twelve inches of the intestine and is fixed to the front of the lumbar vertebræ, it continues the canal from the pyloric end of the stomach. In shape, it is bent like a

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horseshoe on its side, and encircles the head of the pancreas. About half-way down the duodenum the liver and pancreas pour their secretions in through a common opening.

The jejunum and ileum are names given to the remainder of the small intestine, there is no hard and fast boundary between them, the former is said to be the upper two-fifths and

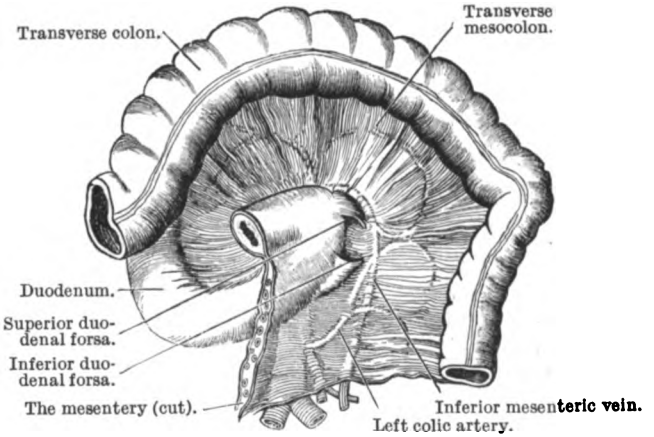

FIG. 37.—The Duodenal Forsal and Folds.

the latter the lower three-fifths of the canal. Both are coiled and closely packed in the middle of the abdomen.

The ileum ends by joining the large intestine at the ileocæcal valve.

The Large Intestine, which is about four to six feet long, is divided into three main portions: (1) the cæcum, a short wide portion situated just below the level of the ileocæcal valve. Into the side, or it may be the end of the cæcum, opens the vermiform

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process, which is a small narrow tube about three inches long, with relatively thick walls and a narrow lumen. It is the blockage of this lumen by a portion of food or by kinking of the tube which causes appendicitis. (2) The colon, which is continuous with the cæcum, forms the principal part of the large intestine. The colon passes up the right side of the body to the liver, and from the liver across the front of the abdomen to the spleen, and from the spleen down the left side of the body

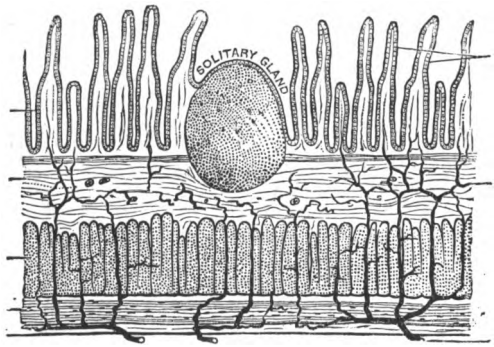

FIG. 38.—Part of the Structure of the Large Intestine.

to the pelvis, receiving the names of ascending, transverse and descending colon.

The ascending and descending colons are fixed in the right and left loins, while the transverse colon is freely movable. A freely movable loop comes next called the sigmoid colon, which enters the pelvis and becomes continuous with the rectum as the straight and dilated last portion is called. The rectum in turn opens on the surface through the anus, which is guarded by a strong muscle, the sphincter.

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The mucous membrane of the upper half of the small intestine is very loose, and is, therefore, thrown into folds which greatly increase its extent. The surface of these folds is covered with countless little projections called the villi, which give it a velvety appearance. The villi are like, but smaller than, the papillæ of the tongue, they are not found in the large intestine. Between the villi are the openings of the tubular glands, which are found along the whole length of the small and large intestines.

Patches of lymph tissue are numerous throughout the small intestine, towards the lower part of which there are larger collections termed agminated patches. In enteric or typhoid fever these patches become ulcerated.

The wall of the large intestine is saccular, and the fibres of the outer muscular or longitudinal layer are collected into three bands instead of forming a complete covering, as in the small intestine; at the rectum they spread out again and cover the whole bowel.

The Liver is the largest gland in the body, and is situated immediately below the diaphragm, chiefly on the right side of the body, under the protection of the right ribs. It is rather triangular in shape, and is divided into right and left lobes, of which the former is much the larger. The circulation of the liver is peculiar, because it is supplied by a comparatively small artery with arterial blood, but on the other hand all the venous blood coming from the stomach and intestines is gathered into a large vein, called the portal vein because it enters the portal of the liver. The portal vein breaks up

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in the liver as if it was an artery into smaller and smaller vessels, till ultimately its blood passes through the liver substance in fine capillaries, so that a ready exchange takes place between the blood and the liver cells. The blood is then gathered up again into larger and larger vessels till it leaves the hepatic veins, which open into the inferior vena cava.

The functions of the liver are—

1. To store up certain foods, such as sugars, which are absorbed after a meal from the intestine, and carried to the liver in the blood of the portal vein; during fasting the sugar is gradually given out again, as the body requires it for use in the muscles.
2. To extract certain waste products from the blood. These it forms into substances which are excreted by the kidney in the urine—such as urea and uric acid. Other waste products it forms into bile, which is excreted along the hepatic ducts, and may be stored in the gall-bladder on the under surface of the liver. The bile has certain uses in digestion and therefore is poured out into the duodenum, together with the pancreatic juice, during the time that digestion is taking place.

The Pancreas is a gland very like the salivary glands. Its head lies in the bend of the duodenum behind the stomach, and its tail stretches across in front of the lumbar vertebræ to reach the spleen. Its duct opens into the duodenum through the same

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openings as the bile duct. Its function is to secrete a very powerful digestive fluid.

Food

Before dealing with digestive processes, it is necessary to say a word about foods and what they really are. All the different varieties of food and drink, which we take by the mouth, are composed of mixtures of the following five classes of food : proteins, carbohydrates, fats, water, salts.

Proteins supply the nitrogenous portion of the diet, and are present in large quantities in all classes of meat, and to a much lesser extent in vegetables and grain.

Carbohydrate is the name given to the large family of the starches and the sugars which are closely allied to one another; in fact, all starches must be digested into sugars before they can be absorbed. Carbohydrates are the chief constituents of such vegetable foods as bread, potatoes, rice, and all forms of sugar.

Fats are the ordinary fatty portions of meat, oils of plants, and cream from milk, which is also made into butter.

Water and Salts need no explanation, except to say that animal life cannot long be supported when deprived of either.

The Digestion of Food

We now deal with the physiological actions of the organs and parts of the alimentary canal, to show what rôle they play in the supply of nourishment to the body. We have already noted the

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different substances under which all foods can be classed. But the forms in which we eat them differ widely in consistency and hardness, as well as in flavour. An apparatus is, therefore, needed by which all forms of food can be reduced to a state of fine division, so that the digestive juices can act upon them.

This apparatus is supplied by the teeth and tongue, which break and mash up the food before passing it on to the stomach. Chewing, therefore, is a great help to digestion. Individuals with no teeth must either be fed upon fluids, as in the case of babies, or must have their food minced up for them, as in old edentulous people who have no false teeth.

Ferments.—A word of explanation is necessary as to the process of digestion. Digestion really means the breaking down of the food from the complex forms in which we eat it into the very simple substances which we can absorb into the blood. This breaking down is performed by a process of fermentation. A ferment is a substance which is capable of breaking down complex substances into simple ones without itself changing in the least, so that it can go on acting on an indefinite amount of substance and never gets used up. Each ferment is only capable of acting on one form of substance, and has no action on any others. These ferments are produced in the juices of the various glands which pour their secretion into the alimentary canal.

Uses and Secretions of the Glands of the Different Parts of the Alimentary Canal

1. **The Mouth and Saliva.**—We have already mentioned the reasons for chewing the food so that

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the digestive juices can penetrate the whole mass. The saliva is secreted chiefly by the three salivary glands, the sublingual, the submaxillary, and the parotid, but it also contains an additional amount of mucin from minute mucous glands scattered all over the mucous membrane of the mouth.

Mucous glands produce a slippery fluid called mucin, which has no digestive qualities, but serves to lubricate the food, so that it passes along easily. They are very numerous in the mouth, where the food is dry, and again in the colon, to allow the passage of the coarse waste products.

The salivary glands produce the saliva, which contains a good deal of mucin, but besides this there is a ferment, ptyalin, which acts on starch and converts it into sugar.

2. **In the Stomach** gastric juice is produced by the minute glands which lie in the mucous membrane of the stomach. The glands are of two kinds, those near the cardiac end of the stomach secrete hydrochloric acid as well as pepsin, while those at the pylorus secrete pepsin only. Gastric juice is therefore acid, and its action is as follows—

(*a*) It soon stops the action of the saliva on the starches, but it has no action on the starches and sugars itself.

(*b*) By means of its acid it dissolves up the fibrous tissue surrounding the fat, and lets the fat free, though it has no action on the fat.

(*c*) Its greatest action is by means of its pepsin, which acts on proteins, which are in the form of meat, turning them into proteoses and some into peptones. Proteoses are intermediate products

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between proteins which cannot be absorbed and peptones which are readily absorbed.

(*d*) Milk is curdled as the result of gastric digestion. The food becomes broken down into a kind of fluid paste, and is now called chyme. The chyme is expelled in small quantities at a time from the stomach into the duodenum, where it becomes intimately mixed with the bile and pancreatic juices.

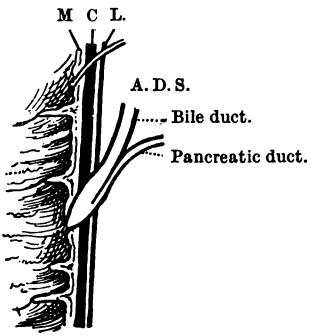

FIG. 39.—Diagram showing the bile and pancreatic ducts piercing the wall of the duodenum obliquely.

A.D.S. Accessory pancreatic duct (of Santorini).
C. Circular muscular fibres.
L. Longitudinal muscular fibres.
M. Mucous coat.

3. **In the Intestines** the bile and pancreatic juices are poured into the duodenum together. They are alkaline, and so neutralise and stop the acid fermentation set up by the stomach. The food becomes milky-looking and is now called chyle. The pancreas has three very powerful ferments—

(*a*) *Trypsin*, which acts on the insoluble proteins and proteoses left over from the stomach, and breaks them down at once into peptones which can be absorbed.

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(*b*) *Amylopsin*, which acts on all the remaining starches and sugars, and converts them into glucose, which is the only form in which sugars can be absorbed into the blood.

(*c*) *Steapsin*, a ferment which splits up all the fats into glycerine. These are absorbed by the cells of the villi and reformed by them into fats.

This last ferment needs the presence of bile to help it, and when a gallstone blocks the bile-duct and causes jaundice, the motions become greasy and a pale clay colour from the amount of fat which is left undigested.

The bile also is an excretion; the liver extracting from the blood substances which are used up, these are passed into the bowel as useless, and to them the colour of the motions is largely due.

The intestinal juice is formed by the numberless glands all along the small intestine, the ferments it contains only serve to help the ferments we have previously mentioned.

Absorption

This takes place at various levels, excess of fluid, such as water, is absorbed in the stomach largely, enough being kept to form the paste-like chyme. In the intestine the peptone, glucose and soaps are absorbed as fast as they are formed, the intestinal contents become less and less as they pass down, until by the time the chyle reaches the ileocæcal valve there is no more of these substances left to digest or absorb.

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Absorption.—The absorption of the simple forms of food which digestion has produced takes place in two ways: (1) certain forms of food, peptones and sugars pass direct into the blood-vessels of the intestinal walls, and are carried away to the portal vein and liver, through which they must pass before they gain the general circulation; (2) other forms of food, including all the fats, pass into the lymph vessels which are in the intestinal wall and so into the thoracic duct, this duct opens directly into the large veins at the root of the neck.

The contents of the intestine are, however, still fluid, and in the large intestine the excess of fluid is removed, and the waste material becomes gradually more solid. The waste products pass onwards and are eventually extruded.

The ready absorption of fluid by the large intestine is turned to good account in cases of hæmorrhage, for the fluid lost can be replaced rapidly by the injection into the bowel of salt and water.

The Ultimate Fate of Food

We can now trace further the fate of the food after absorption. The peptones are passed into the blood and are reformed into proteins to replace those used up in the tissues. The starches and sugars, now changed into glucose, are carried by the portal vein to the liver, where the glucose is abstracted and stored up, only being given out again in small quantities as it is needed for the use of the muscles. In the disease called diabetes, the liver allows too much glucose to circulate in the blood, with the result that the kidneys excrete the excess in the urine, so that it is wasted.

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One of the chief functions of the liver is to store up the glucose, and give it out to the blood in the right quantities. The fat all passes into the lymph vessels of the intestine, so that after each meal these become full of a milky fluid, and are therefore called lacteals. The fat gradually passes from the large lymph vessels into the blood-vessels at the root of the neck. The fat is stored up as fat globules in the cells of the loose fibrous tissues of the body, chiefly in the subcutaneous tissues and abdomen; it is used up as it is wanted.

The muscles are the place where the food is chiefly used up. They are the organs by which we move and perform work, they are constantly producing energy, and, therefore, they must have a constant supply to replace that used. They are in fact the engines of the body. The food is carried to them to be burnt up to produce energy. The oxygen of the blood supplies the draft to burn the food into carbon dioxide and water, which are given off to the blood, and are, as it were, the fumes and smoke of the furnace. When running or doing violent work a lot of fuel in the form of glucose and fat is burnt up, and we become out of breath and pant in our efforts to supply enough oxygen to burn them up, at the same time we give off into the air we breathe large quantities of carbon dioxide and water, which result from the burning.

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CHAPTER XI

DISEASES OF THE DIGESTIVE SYSTEM

Diseases of the Alimentary Canal have many symptoms which are common to all, some being more urgent in one, some in another—Indigestion, Vomiting, Colic, Constipation, Diarrhœa.

A few remarks on these are desirable before mentioning the chief points of management of the severer abdominal diseases.

Dyspepsia or Indigestion is the result of an upset in the normal process of digestion. It may be due to the taking of unsuitable food, too large a quantity of food, bolting the food without sufficient mastication, or to disease in the digestive organs. It is characterised by many symptoms. Uneasiness and a sense of fulness is felt in the upper part of the abdomen, this uneasiness may amount to pain, and in severe cases the pain may be extreme. The relation between the onset of the pain and the taking of food should be noted. Eructations may take place from fermentation on the stomach with the formation of gas, which when it escapes gives relief to the symptoms for a time.

A return of some of the stomach contents to the back of the throat is common; when the fluid which comes up is acrid and burning, it is called heart-burn, when watery or tasteless, water-brash. The

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appetite is lost, the tongue is usually flabby and furred. The bowels are irregular, and the patient is troubled with wind. The patient has headaches and feels out of sorts.

Management.—All that is required in the slighter cases is that the error in diet should be corrected. Simple food taken without hurry, regular habits and attention to the bowels.

Vomiting is often the result of indigestion, the stomach ejecting the contents which it cannot digest. The vomiting is preceded by a period of nausea and faintness, and in these cases the relief after the act is almost immediate. Vomiting may, however, occur from other causes, such as disease interfering with the functions of any of the abdominal viscera, strangulation of gut in a hernia, obstruction of the intestine, or in inflammation in the abdomen. It also ushers in many of the acute infective diseases, especially in children. Occasionally it is a symptom of brain trouble, kidney disease or uterine disturbance. Vomiting is also met with in hysterical people.

Management.—The relation of the vomiting to the taking of food should be noted, whether it is preceded by pain or nausea, whether it comes on at a particular time of day, such as the morning vomiting of pregnancy or hysteria. The vomited matter should be inspected, and, if necessary, kept to show to the medical man. It may consist merely of the partially digested food, it may be yellow fluid from an empty stomach, or it may contain blood, in which case there is said to be hæmatemesis. If the blood is bright in colour and in clots, it has recently been shed, but blood which has remained in the

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stomach some time is altered and comes up dark brown or blackish, very like coffee-grounds. Sometimes the vomit is green, showing the presence of bile, sometimes yellow and offensive with a fæcal odour, showing that the intestinal contents have been brought up. Where there is much fermentation the vomit may be frothy.

Acute Peritonitis is the inflammation of the membrane which lines the abdominal cavity, and forms the surface of all the viscera and intestines. The membrane is smooth and moist, so that the coils of intestine move easily on each other.

Inflammation of the intestine is caused by the presence of bacteria, though their action may be favoured by a chill or other depressing factors. Broadly speaking, the bacteria come from two sources, they can get to the peritoneum from the outside by a wound, such as a stab or a bullet wound, or they may get through the wall of the intestine; this latter is by far the commoner of the two ways. They can escape through the wall of the intestine when perforation takes place anywhere, as in perforation of a gastric ulcer or a vermiform process. They can also escape during inflammation of the walls of the hollow viscera, such as an inflamed vermiform process, gall-bladder, or strangulated piece of gut, or from intestine which has been injured by a blow. Peritonitis is therefore feared, and has to be guarded against, in nearly all severe abdominal conditions. It is the prevention and treatment of this that forms a large part of surgery.

Symptoms and Pathology.—Peritonitis is conveniently divided up into—

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1. Acute General Peritonitis.
2. Acute Local Peritonitis.

Acute General Peritonitis means that there is a widespread infection of the peritoneal cavity. The septic material becomes widely diffused all over the abdomen. Fluid is poured out by the peritoneum to dilute the poison. The patient usually has warning of trouble in the particular organ affected for some time previously, but this is not always the case. When rupture of the intestine and infection occur there is sudden acute pain, and vomiting accompanied by pain. The pain may be local at first, but there is soon great tenderness all over the abdomen, so that the patient complains whenever it is touched, or whenever he has to move. The knees are drawn up to keep off the weight of the clothes. The abdomen becomes swollen and distended with wind, while the muscles of the abdomen wall are held rigid. Constipation is marked, and there is pain on giving an enema, or when the bladder is emptied. There is great thirst, the tongue is dry and brown and the face assumes an abdominal look, with the expression anxious, the face pinched, the eyes sunken and the nose sharp. Towards the end, the pain may be succeeded by anæsthesia as the senses become dulled; delirium may precede death.

Acute Local Peritonitis.—When the intestine become diseased, the change spreads to all the coats, so that there is slight inflammation of the peritoneal covering. As a result of this the

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peritoneum thickens locally, becomes sticky, and adheres to any coils of intestine or peritoneum of the abdominal wall near by. This adhesion, slight at first, rapidly becomes stronger, and the peritoneal surfaces become glued together with firm adhesions, so that the inflamed coil becomes surrounded, and completely shut off from the general cavity of the peritoneum. These adhesions are nature's method of preventing a general peritonitis. If rupture of the coil now takes place, the peritonitis and pus are confined by the adhesions to this local area. Needless to say, if the abscess spreads rapidly, and the adhesions are not strong, they burst and a general peritonitis is set up in spite of them. The early symptoms are very like those of the general form of acute peritonitis, but are not so sudden or severe. At first they are vague pains in the abdomen, chiefly round the umbilicus, this is accompanied by nausea or vomiting, there is a slight rise of temperature, and slight quickening of the pulse. There is usually constipation and some distension. Later all the symptoms point to the area of local peritonitis, say the gall-bladder, the vermiform process, or the pelvis. As time goes on there must be great anxiety as to whether a general peritonitis is about to be set up or no.

Management.—In both forms of peritonitis it is most important to make out and remove the cause of the infection. In the generalised form, this is the only method of treatment which holds out any hope of success. If the cause remains in doubt, the

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patient should be put to bed and not allowed to get up. Hot stupes to the abdomen will relieve the pain, and an enema should be given to open the bowels. The temperature must be taken and noted carefully, together with the rate of the pulse and respirations. Morphia should not be given before the diagnosis is made, but as soon as it is decided to operate there is no reason to withhold it. It is becoming more and more widely recognised that in all acute abdominal conditions about which there is a doubt the safest course lies in operation and not in delay until there are symptoms of widespread peritonitis. After the operation has been performed the patient should be put in a sitting position in bed (Fowler's position) as soon as he has recovered from the effects of the anæsthetic. The absorption of toxins goes on less rapidly from the lower, than from the upper, part of the peritoneal cavity, it is therefore wise to sit the patient up so that all the pus collects in the pelvis where absorption is slow. As a rule, too, provision has been made to drain the lower part by an incision, through which a rubber tube reaches to the bottom of the pelvis.

Small doses of calomel may be given hourly to get the bowels to act so that elimination may proceed freely.

Rectal Saline.—Additional fluid may be given by the rectum, in the following manner. An ordinary douche-can is filled with saline solution, heated to a temperature of about 100° F. To the douche-can is attached a long rubber tube which ends in a glass piece on which is fitted a small catheter. The catheter is oiled and introduced into the rectum. If there is a tap on the tube this should be turned

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so that the saline drips slowly from the catheter. This must be done before the catheter is introduced. The douche-can is hung near the head of the bed, and wrapped round with a towel to keep in the heat. The rubber tube should also be prevented from getting cool. If there is no tap fitted to the tube, then the douche-can must be put no higher than a few inches above the level of the rectum. The fluid must be absorbed by the action of the mucous membrane which soaks it up. Forcing the fluid in, by raising the can high, defeats its own end, as the rectum is dilated, discomfort is caused, and the muscles contract and expel the fluid in the bed. The usual rate of absorption is about a pint an hour, and two or three hours rest can be given between each pint. A small catheter in the rectum causes less irritation than a large rubber tube.

Vomiting may be allayed by sucking small pieces of ice; if vomiting is not troublesome the patient should be allowed to drink water or clear beverages freely.

Gastric Conditions.—Gastric Ulcer is a condition which attacks young adults of both sexes, but chiefly women of the domestic servant class. The patients are usually very anæmic and suffer from chronic indigestion.

The Symptoms are as a rule striking. Pain which comes within half-an-hour of the taking of food. Vomiting which soon follows the onset of the pain. To these, in severe cases, must be added hæmatemesis and malæna. Hæmatemesis is the vomiting up of blood. Melæna is the passage of blood in the stools, in which case the blood is altered to a thick black liquid like tar.

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Management.—The diet of a person with gastric ulcer must be carefully considered, only light and easily digested fluids should be given, and the patient should be kept in bed under medical supervision.

In severe cases no food is given by the mouth except a little water, the strength being maintained by nutrient enemata, until the gastric symptoms subside. After this, peptonised fluids may be given by the mouth, and when the ulcer is judged to be healed, the diet can be gradually increased till ordinary food is taken.

Hæmatemesis may be slight or severe. In the slight cases treatment for gastric ulcer should be started at once. In the severe cases the immediate object is to stay the hæmorrhage. Sometimes there is one large hæmorrhage, after which fainting occurs, sometimes this is followed by two or three others equally severe and threatening life. The patient should be put to bed at once, and kept undisturbed. If fainting has occurred, the foot of the bed should be raised and the head kept low. Turpentine stupes may be applied to the stomach to relieve pain. As a rule morphia is given and no food allowed by the mouth. For some days subsequently blood may be passed in the stools. Nutrient enemata are given, and an attempt made to induce the ulcer to heal. The hæmorrhage is very rarely fatal, though recovery may be slow. In the later stages, iron tonics are necessary to correct the anæmia. Occasionally blood is brought up by malingerers, the blood being sucked from the lips and gums and swallowed previously. If the ulcer cannot be induced to heal, and becomes chronic with occasional acute symptoms, the patient should be

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operated upon and have a gastro-enterostomy performed. By this operation a communication is established between the stomach and the first part of the small intestine, this usually gives permanent relief.

Rupture or Perforation of an Ulcer.—This is caused by the floor of the ulcer giving way, and the contents of the stomach escaping into the peritoneal cavity, where they set up a very acute general peritonitis. It usually takes place after a meal. Acute agonising pain is suddenly felt, and the person becomes collapsed and may faint from the shock. If unrelieved by operation, the peritonitis will prove fatal in a few days, it is therefore of prime importance that the condition be recognised and surgical aid obtained as soon as possible.

The operation aims at closing the aperture in the stomach, removing the gastric contents from the peritoneal cavity, and draining off the fluid which is poured out as the result of the peritonitis.

In many cases, if the operation is performed in time, the ulcer is permanently healed by the operation.

The treatment is the same as that detailed for acute general peritonitis.

Gastrostomy is the formation of a permanent opening into the stomach, so that food can be introduced without passing through the mouth and œsophagus. The operation is needed in cases where there is obstruction to the passage of food down the œsophagus, the most common cause being a growth in the wall of the tube.

The patient is usually very emaciated from the inability to take food.

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Operation.—There are several methods of making the opening, but most commonly a rubber tube is fastened into the wall of the stomach with stitches, so that the opening will become valvular, and not allow the escape of the gastric juice later. A No. 12 catheter is a suitable size for the tube. At the operation, the nurse should prepare some peptonised milk which has been brought to the boil and so sterilised, so that a feed can be given on the table to prove that the tube works well. The tube, which is clamped at the end of the operation, should be fastened under the binder, so as to prevent the patient pulling it out in his semi-conscious condition as he recovers from the anæsthetic. For several days nothing but sterilised food should be given by the tube, so that there is no chance of contaminating the wound. When the wound is soundly healed, this precaution is no longer necessary. After the tube becomes loose, it need only be inserted at meal times. The patient should be well fed and will probably gain weight rapidly. Care should be taken to wipe away any gastric juice which may find its way out when withdrawing the tube, or the skin around the orifice will become digested and sore. If this does happen, the skin should be protected against further injury by applying boracic ointment thickly over the surface.

Gastro-enterostomy is the formation of a permanent opening between the stomach and the upper part of the small intestine. The small intestine is usually joined to the back of the lower part of the stomach. The operation is performed in cases where there is an obstruction at the pylorus of the stomach which prevents the organ

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emptying itself into the duodenum, and in some cases of chronic gastric ulcer or an enlargement of the stomach.

Management.—After the operation it is important that no food should be given by the stomach till the union between the two parts is sound. If there is thirst sips of water may be given, but any food that is necessary should be given in the form of nutrient enemata. After a few days the surgeon may order food in fluid form, and the usual diet is returned to by slow degrees.

To wash out the Stomach.—A long rubber stomach tube is taken and to the end is attached an ordinary glass funnel. The tube and funnel should be boiled before use. The tube is usually lubricated with glycerine, but this is not necessary, as the tube will pass easily if wet.

The patient should sit up and have the nature of the procedure explained to him. He can be assured that he will not choke, and all that he has to do is to breath easily, taking short breaths. The patient bends the head slightly forward—he should not put his head back—the mouth is opened and the tube passed in, the patient swallows the end and the surgeon continues to push in the tube while the patient breathes. The tube is passed in about eighteen inches. With drunken people and those who struggle, assistance is needed to hold their heads, and a gag is necessary to prevent them biting the tube. When the tube has passed into the stomach, bicarbonate of soda, a dram to the pint, or weak potassium permanganate solution, is poured into the funnel, which is raised above the patient's head. As the fluid runs in more is added to the

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funnel until about a pint has passed, or until the patient makes a signal that he feels uncomfortable. As soon as this happens the funnel with some fluid still in, is lowered and inverted over a pail, when the fluid will return from the stomach by syphonage. The manœuvre is then repeated until the fluid returns from the stomach quite clear. If the flow is suddenly checked as it returns, probably a piece of food is blocking the end of the tube, this can be dislodged by passing in a little more fluid. The tube is easily removed by drawing on it quickly and steadily. After practice a person can wash out his own stomach.

Feeding through a Stomach Tube.—This is carried out in asylums where people of unsound mind refuse to take their food. Plenty of assistance should be at hand so that the patients can suddenly and easily be overcome. A gag is slipped into the mouth and fixed while the head is held steady. The tube is then passed into the stomach and the fluid meal, of cream, eggs and beef juice, is poured down. The tube is then removed. Patients with queer ideas, who believe they cannot eat, are kept alive for years, never taking meals in any other way. There is no danger or harm in the process, though if the patient struggles violently, greater force is needed to restrain him. If he pulls the tube out or vomits up the stomach contents, and then takes a quick breath, he may manage to aspirate some of the food into his lungs, and so set up pneumonia, for which unmerited blame may fall upon the attendants.

The stomach tube is of such a size as to render it almost impossible to pass it into the larynx.

Appendicitis is a very common disease. It is

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caused by some obstruction to the outflow of the contents of the vermiform process. The walls of the appendix are thick and strong, while the lumen is very small and easily blocked. The obstruction may be caused in many ways. The commonest is by portions of indigestible food finding their way in and becoming rolled into a small hard mass which cannot be pushed out, or a kink of the organ may occur from an adhesion forming, possibly from a previous attack, or a constriction of the wall taking place as the result of former ulceration. In addition to this, foreign bodies such as pips, seeds or intestinal worms may cause the blockage.

Symptoms.—These may be slight or severe, depending on the acuteness of the attack. In slight cases there is a feeling of uneasiness in the abdomen, or slight pain near the umbilicus, loss of appetite, and a feeling of nausea or the patient may just be sick. The pulse may be increased in rate to about 85 to 90 and the temperature up to 99° or 100°. In more severe cases the pain comes on suddenly and is severe all across the middle of the abdomen. Often the onset occurs in the middle of the night or early morning. There is vomiting and a feeling of faintness. The temperature rises and there may be a rigor. Tenderness is complained of in pressing firmly in the right iliac fossa, and the abdomen becomes more rigid on the right side.

Course of the Affection.—Whatever the cause may be the result is the same, the contents accumulate behind and block, and colicky pains are the result. Inflammation is set up, the walls swell, still further increasing the block, and fluid collects in greater quantity behind the obstruction.

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Eventually one of two things must happen, either the vermiform process succeeds in overcoming the block, or the inflammation increases until the organ bursts or perforates and the contents escape.

1. If the block is overcome the attack subsides and the patient gets well, but the adhesions or injury to the vermiform process render a future attack very likely.

2. On the other hand, if the inflammation increases, adhesions form round about between the process and the abdominal wall or the neighbouring coils of intestine, so that the general cavity of the peritoneum is shut off and when the process bursts and an abscess forms, it is already surrounded by adhesions and so is shut off, then there is an acute local peritonitis. The patient's condition is now very critical, for the future course of the abscess is quite uncertain. It may absorb, leaving adhesions, it may burst into the bowel and so escape, or it may burst into the peritoneal cavity, through the adhesions, and set up an acute general peritonitis from which the patient may die.

We have no means of knowing what course appendicitis will pursue.

3. If the attack is very acute, the adhesions may not have formed sufficiently before the appendix bursts, and so the peritoneal cavity is infected at once.

Considerations.—It is quite true that many cases subside without operation, and any one may elect to chance what may happen and refuse operation. If he gets well, he knows he is very likely to have another attack which will probably be a worse one, and he must go on chancing matters till either he

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gets no more attacks, or he gets one so bad that he has peritonitis and must have an operation to save his life.

For this reason any one who has come through one attack safely is well advised to have the operation performed when everything has quietened down, and before another attack comes on. Some people refuse operation time after time and spend months as invalids in consequence.

If the patient waits till there is an abscess, or still worse, till there is general peritonitis, the condition is much more severe, nor is the operation so satisfactory in its results. The patient is weeks, and often months, recovering, and is left in the end with a weakened abdominal wall for which another operation may be required at a later date.

It is deemed safest to have the operation if possible as soon as the attack is diagnosed and before any perforation or leakage has occurred. There is little risk at this stage. There is also very small risk of a hernia occurring, or the abdominal wall being weakened in any way.

Management.—1. *Early Operation or Operation in the Quiescent Period.* In this case the operation is a clean operation. The abdominal wall is sewn up and no tube inserted. A small dose of morphia may be required the first night and perhaps the second night. The water may have to be drawn off the first time. Sips of water or clear tea are given by the mouth, and no food allowed for twelve hours, after which time clear soups may be given. Patients are often troubled with wind for the first three days, and if there is vomiting from the anæsthetic the straining may cause some pain. The knees

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should be bent over a bolster and the patient should lie on the back.

On the second or third day an aperient should be given, small doses of calomel frequently repeated are very usual, followed next morning by a dose of salts and an enema. As soon as the bowels move the patient is much more comfortable and can be allowed to take more nourishment. The stitches are removed about the eighth day and after this the patient can lie as he likes. Convalescence is, as a rule, uneventful, he can be back at his work, should he so wish, at the end of a month.

2. *Operation where there is an Abscess or Peritonitis.*—Here the operation is not a clean one, septic organisms having already escaped from the injured gut into the peritoneal cavity. After the pus has been let out and the vermiform process removed, a large drainage tube must be put in to the bottom of the abscess, often right to the bottom of the pelvis, and can only be removed when the pus has ceased to form.

As soon as the patient has recovered from the anæsthetic he should be put in the sitting-up position (Fowler's position), and kept in this position by a pillow under the knees, so that the septic fluid will gravitate down to the bottom of the pelvis.

Continuous saline should be given per rectum with all due precautions (see p. 151).

Often it is an advantage to begin giving small doses of calomel at once to open the bowels and thus help elimination of the toxins. If there is much pain hot fomentations or turpentine stupes may be applied; morphia should, if possible, be avoided as tending to confine the bowels. The dressings will

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have to be changed daily, and this often is a painful process if the tube has to be removed and is at all difficult to reinsert. The tube is shortened gradually and is eventually left out; this, however, is only done when there is no longer any fear of pus forming in the depths of the wound. The length of time the tube must be kept in varies with each case. After healing has taken place the scar is weak, and there is a great tendency for a hernia to form where the tube has kept the margins of the wound apart.

Complications.—These are almost wholly the result of sepsis and do not occur in those cases which are operated upon before the contents of the vermiform process have been allowed to contaminate the peritoneum, nor do they occur in operations performed during the quiescent period.

Secondary Abscesses, or pockets of pus as they are often called, form, if the tube is removed too soon, or may form in between the coils of intestine in places which are not properly drained by the tube. Their presence can be suspected if the temperature suddenly rises and remains unsteady; the pulse-rate increases and it is evident that the patient is not doing well. These pockets of pus must be found and drained, either through the old wound, or if necessary, through a new one.

Colic may be a very distressing complication, causing great and almost continuous spasms of pain owing to the difficulty met in the onward passage of the intestinal contents from the presence of the inflammatory adhesions and kinks. Fomentations and enemas may help, also antispasmodics such as peppermint may be given by the mouth, but the contents must be driven on in spite of the

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pain. As the sepsis diminishes and the wound heals, the adhesions dissolve to a great extent and the symptoms of chronic obstruction subside. Rarely acute obstruction develops.

Subphrenic Abscess.—This is a well-recognised collection of pus which forms under the diaphragm, usually on the left side. It presents all the symptoms of a collection of pus, but is often exceedingly difficult to locate. It requires the resection of a part of a rib and the insertion of a tube through the diaphragm. The operation is very like that for empyema, only the tube is put into the abdominal cavity and not into the thorax. The management is also very similar.

3. *If no Operation is Undertaken* a very close watch must be kept upon the patient so that an idea may be gathered as soon as possible as to what is happening. If all goes well the temperature and pulse do not rise much above 100, the pain is not severe, and the vomiting does not continue. An ice-bag may be applied, but sometimes greater relief is obtained from fomentations. The bowels should be encouraged to act by enemata or very small doses of calomel, such as half of a grain every two hours, but no purgative should be given except by order of the doctor. Should there be sudden relief of pain, followed in a few hours by a rising temperature and increase in the pulse-rate, the doctor should be informed at once, as the vermiform process has probably perforated. If this is the case the abdomen becomes more rigid and the tenderness is no longer confined to the right side, but becomes general. There will also be difficulty or pain in passing water. The recognition of these early symptoms of peri-

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tonitis are most important, as delay in operating may cost the patient his life.

Obstruction. — Obstruction means that there is an impediment to the passage onward of the intestinal contents. The causes are many, such as adhesions, kinks, narrowing from the contraction of the scars of old ulcers, or growths; the latter are very common in old people. Acute inflammatory conditions may bring about temporary paralysis of the gut.

The symptoms are divided into chronic and acute. In *Chronic Obstruction* there is great difficulty with the bowels, purgatives are needed in large doses, constipation alternates with diarrhœa, colicky pains are felt, there is occasional vomiting, the motions are small and ill-formed, and often contain mucus and blood. Loss of weight is common.

Management.—The bowels should be regulated carefully and the diet should be light and not likely to leave much residue. Carefully selected purgatives should be given and enemata are needed. Should the obstruction become acute no time should be lost, but relief should be obtained by operation.

Acute Obstruction very gradually supervenes after a prolonged chronic stage, it may, however, arise without such a stage, this is nearly always the case in all forms of strangulation, which are dealt with separately.

The *symptoms* of acute obstruction are always urgent. There is pain in the abdomen. The vomiting is peculiar and progressive in character, first the stomach contents are voided, then the vomit becomes green, indicating the regurgitation of bile, and later it may be a yellow fluid with a

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horribly fæcal odour. Nothing passes by the bowel —not even wind. The abdomen becomes distended. The pulse may or may not be rapid at first but quickens later. The temperature may be sub-normal.

With such symptoms no time should be lost before obtaining the advice of a medical man, as an operation may be needed to relieve the obstruction.

Strangulation of the Intestine includes obstruction, but in addition to interference with the onward passage of the gut contents, there is also interference with the circulation in the piece of gut, so that unless relieved within a few hours the gut will die, the contents escape, and peritonitis and death will be the final result. Strangulation is apt to occur in conditions like a hernia, or by the gut becoming twisted on itself (volvulus), by one piece of gut passing into another (intussusception), or by the gut becoming snared by a band-like adhesion.

The symptoms are those of very acute obstruction. The remedy is nearly always surgical. The hernia must be relieved, the volvulus untwisted, the intussusception reduced, or the band divided. There should be no delay.

Gall Stone Colic is due to the presence of a gall-stone in the gall bladder or in one of the bile ducts.

The symptoms resemble those of renal colic, except that there are no renal symptoms. People who suffer from gallstones are about middle age, usually stout females. The pain may be intense during the attack, the person rolling about curled up with the pain. There is vomiting, faintness and profuse perspiration. The pain is in the upper part of the abdomen on the right side, but is often felt through

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to the back of the right shoulder. The attack may end suddenly with the passage of the stone into the duodenum, or the pain may become less, but last for some time as the stone remains partly blocking the duct.

The pain is usually accompanied by jaundice.

Jaundice is the name given to the yellow discolouration of the surface of the body due to the absorption of bile. The absorption only takes place if there is some obstruction to the flow of the bile into the duodenum. The colour may be deep yellow or even bronze in the severe and long-standing cases, but in the slight cases it may only be a slight yellow tinge, best seen in the whites of the eyes. It is often accompanied by great itching of the skin.

As the bile cannot get into the bowel, it has to be eliminated by the kidneys, and the urine in consequence becomes dark greenish brown in colour. Owing to the absence of bile from the intestine, digestion is incomplete and the fats are not absorbed. The motions therefore, are light-coloured and greasy from the unabsorbed fats, they are often said to be clay-coloured. The patient suffers from loss of appetite, nausea, and a feeling of great depression. If the condition lasts long wasting is noticed.

Management.—Jaundice which is due to dyspepsia soon passes off with attention to diet. If, however, it is accompanied by spasms of pain, and vomiting, it is probably due to gallstones, and may necessitate an operation for their removal. Irritation from gallstones if allowed to continue over many months is a potent factor in the starting of cancer of the

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liver and stomach. For the pain of gallstone colic, hot stupes or a hot bath are often helpful, but in many cases nothing but morphia will give relief. Some severe cases of jaundice are caused by cancerous growths of the liver, stomach or pancreas. In cases of suspected gallstones the evacuations should be examined for the passage of stones.

Colotomy or Colostomy is the formation of an artificial anus by making an opening into some part of the colon. The operation is necessary in cases of acute obstruction where the passage of intestinal contents is quite blocked. It is also sometimes performed as a preliminary measure to operations on the rectum. The opening is usually made on the left side of the lower part of the abdomen. The operation consists in bringing a portion of the large intestine to the surface, fastening it in position and then when fixed, a glass colotomy tube is tied into the bowel. To this glass tube a long rubber tube is attached to carry the evacuations from the interior of the bowel away from the wound, so that the latter does not become infected. In cases where there is no urgency, the bowel, after it is fixed, need not be opened for some days, by that time adhesions will have sealed off the peritoneal cavity from all fear of infection.

Management of these cases requires care. Immediately after the operation the rubber tube attached to the glass colotomy tube should be clamped while the patient is being carried back to bed. The clamp is then removed and the end of the tube laid over the edge of the bed into a pail, which contains some sanitas or other deodorant. The pail is covered with a damp cloth. If a cradle

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is arranged over the abdomen the nurse must see that it does not obstruct the rubber tube. Very frequently there is a great rush of fæcal material directly the patient gets back to bed. A nurse should remain constantly with the patient to see that he does not pull out the tube by an incautious movement of the hands before he has recovered from the anæsthetic. In the pattern of the colotomy

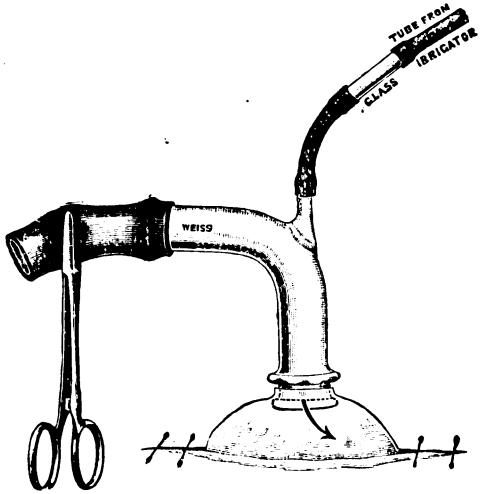

FIG. 40A.—Fitzwilliam's Colotomy Tube.

tube illustrated here, the rubber tube can be syringed through by introducing fluid into the small side tube. If the waste tube is clamped and fluid introduced by the side tube, it will run into the bowel, and the interior of the bowel can be flushed out. This is a very great advantage over the old-fashioned pattern of tube.

About the third or fourth day the tube will become loose, but by that time the adhesions will

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have shut off the peritoneal cavity. Very often the surgeon then cuts away the surplus bowel which projects from the wound. No anæsthetic is required as the gut is insensitive. The wound must then have copious dressings applied to receive the contents of the bowel, the dressings too, will need changing frequently. When the wound has healed soundly the lower part of the bowel should be flushed

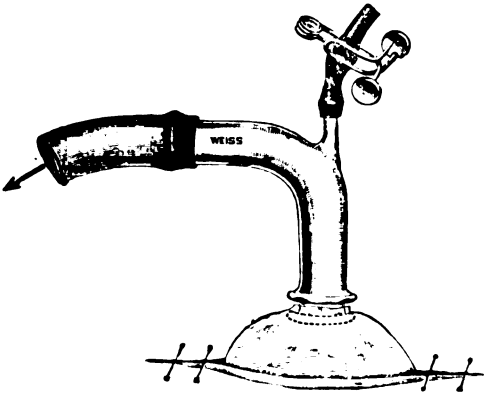

FIG. 40B.

through, and very possibly the fluid put in at the rectum can be made to come out of the colotomy opening. This part of the bowel should be flushed periodically.

Later, when the patient is allowed up, a truss can be worn with a plug fitting into the bowel which will prevent any escape of the contents. Care is needed to create a habit of the bowels acting regularly at a certain time, as this saves a great deal of trouble and annoyance.

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CHAPTER XII

THE KIDNEYS AND EXAMINATION OF THE URINE

The Kidneys

THE two kidneys are placed deeply in the loins, one on each side of the upper lumbar vertebræ behind the peritoneum, the right being a little lower than the left.

They are about four inches long, two and a half inches wide, and about one and a half inches thick, and lie in a loose sheath of delicate fat which helps to keep them in place. The term kidney-shaped needs no explanation. In the concave surface, which is towards the vertebral column, is a depression called the hilus, where the blood-vessels and nerves enter and leave the organ. The duct of the kidney, called the ureter, leaves at the same spot.

The surface of the kidney is covered by a smooth capsule. On cutting the kidney across it is seen to be composed of an outer portion or cortex and an inner part or medulla.

The medullary substance seems to be made up of pyramidal-shaped masses whose bases are at the cortex and whose apices project free into the interior of a small, cup-shaped space called a calyx. Each calyx is connected with a space called the pelvis or basin of the kidney, which is the expanded upper end of the ureter or duct of the kidney by which

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the urine is carried to the bladder. The streaked appearance of the medullary substance is caused by bundles of tubules running to open at the apex of the pyramid.

The Function of the Kidney is to excrete the waste matters from the blood. It is therefore supplied by a very large artery, which divides in the substance

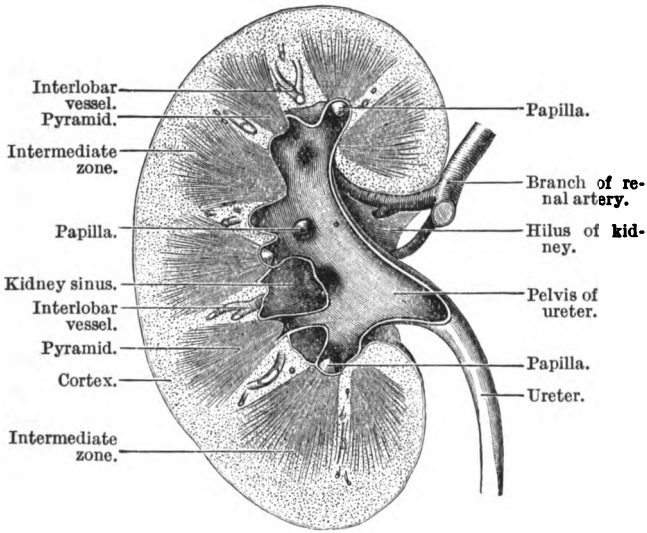

FIG. 41.—Longitudinal Section of the Kidney, opening up the Kidney Sinus.

of the kidneys, until it ends in the cortex as small bunches of capillaries, which project into the ends of the kidney or urinary tubules. The watery constituents of the urine pass through the walls of the capillaries into the tubules by a process of filtration.

The blood is then lead through another set of capillaries among which the urinary tubules pass in a highly convoluted manner both in the cortex

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and medulla. The tubules are lined by the glandular cells of the kidney, which abstract from the blood all the waste products, and pass them into the interior of the tubule, down which they are washed.

The blood thus purified is gathered into veins and leaves the organ. The waste products pass down the tubules which join together and at last pass straight down the pyramids, to open at the apices, where they pour the urine into the calices and so into the ureter. The ureter conveys the urine to the bladder.

The Bladder is a muscular bag which when empty lies in the front of the pelvis just behind the pubic bones. As the urine flows in, the bladder distends upwards until, when quite full, it reaches almost as high as the umbilicus and can be felt in the lower part of the abdomen.

There are three openings at the base of the bladder; two of these are the lower ends of the ureters, which pierce the bladder wall very obliquely so that while the urine can pass easily into the organ, but when once in, it cannot pass back. The other opening is that of the urethra by which the bladder is emptied. A strong muscle, the sphincter of the bladder, surrounds this opening which is often called the neck of the bladder. In the male the neck of the bladder and first part of the urethra are surrounded by the prostate gland, the ducts of which open into the urethra. In the female no such gland exists.

Examination of the Urine

The amount of urine passed in the twenty-four hours averages between two and three pints.

The colour should be pale yellow and clear,

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though after standing a faint cloud of mucus may appear at the bottom of the vessel.

The reaction should be acid, that is to say, if a piece of blue litmus paper be moistened with it, the colour of the wetted portion should be turned red. With alkaline urine red litmus paper is turned blue.

The specific gravity when tested by a uriometer should be about 1020.

The urine may deviate from this normal standard very considerably without there being any actual disease. The quantity may be greatly increased on drinking a lot of fluid, during nervous stress, or in hysterical conditions; at the same time the colour will become paler and the specific gravity may fall as low as 1010. On the other hand, less urine, of a higher colour and higher specific gravity, is passed in hot weather when perspiration is very free.

Deposits of different kinds may sometimes be observed to form in urine on standing.

Urates are deposited usually after prolonged muscular strain, especially if continued for some days, as on walking or cycling tours. Urates are deposited as a brick-red precipitate as the urine becomes cool. If placed in a test-tube and heated they gradually dissolve up again.

Phosphates readily form in alkaline urine on standing. On boiling they become more evident, but disappear on adding a few drops of acetic acid.

Uric Acid Crystals are sometimes deposited in gouty individuals with very acid urine, as fine sand-like grains of red pepper.

Mucus and Pus may be seen, the former as a

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flocculent cloudy deposit, the latter as a thick, heavy layer of white or greenish-yellow colour, lying at the bottom of muddy-looking urine, which is usually alkaline in reaction.

Tests.

Albumin in the urine or *Albuminuria* is the result of nephritis; its presence may be detected by one of the following tests—

1. *Heat.*—Fill a test-tube two-thirds full of urine. Boil the upper part of the fluid. If albumin or excess of phosphates are present a white cloud appears: add a few drops of acetic acid; if the cloud is due to phosphates it will clear up; if due to albumin the cloud remains and even gets denser.
2. *Nitric Acid Test.*—Pour a little nitric acid into a test-tube, slope the tube and pour in a little urine very slowly. If albumin is present a white ring will appear at the junction of the two fluids.

Sugar is present in the urine in cases of diabetes. Its presence may be suspected by the large quantity of urine passed, and from its high specific gravity, which may be 1040.

Fehling's Test.—Fehling's solution is made up by adding small quantities of the two constituent solutions to a test-tube. The solution should be a clear blue, due to a salt of copper. This blue solution is boiled to make sure that it will not reduce before adding the suspected urine. The urine is then added and the mixture boiled, when,

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if sugar is present, the blue copper salt is reduced and precipitated in a dense brick-red colour.

Hæmaturia.—Blood may be present in the urine in sufficient quantity to colour the fluid red, but when present in small amounts the urine assumes a smoky tinge.

To test for blood, pour a little urine into a test-tube and add a few drops of tincture of guaiacum, shake the mixture, slant the tube and pour in carefully about a drachm of ozonic ether, which, being lighter, will float on top. If blood is present a blue ring will appear at the junction of the fluids.

Bile when present in the urine in small quantities gives to the fluid a greenish tinge; in large quantities it changes the colour to dark olive green or to dark brown or black, resembling porter. Bile pigment is detected by adding strong nitric acid to the urine, when a play of colours will be seen: green, yellow, violet and blue.

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CHAPTER XIII

DISEASES OF THE KIDNEYS AND URINARY SYSTEM

Diseases of the Kidneys

Acute Inflammation of the Kidney is usually known as acute Bright's disease. It is induced by the presence in the blood of substances which irritate the kidneys and so cause acute inflammation, such as the toxins of scarlet fever, diphtheria or erysipelas; it may also occur during pregnancy, and sometimes it may come on suddenly when no cause can be found.

Certain drugs when given in large doses irritate the kidneys, for instance, copaiba, sandal wood oil, turpentine and perchloride of mercury.

Symptoms.—In severe cases the onset is sudden, with fever, chilliness, vomiting, headache, gastric disturbances and pain in the loins. The urine is scanty and may even be suppressed, and what is passed is highly coloured, turbid and often smoky in appearance from the presence of blood. If boiled it will be found to contain a large amount of albumin, so much even that boiling may turn it solid. The eyelids, face, ankles and dependent parts of the body are soon noticed to swell, and can be made to pit on pressure; this condition is known as dropsy. The skin has an appearance which has been described as pale, puffy and pasty.

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Complications sometimes occur, such as great dyspnœa from swelling of the glottis, or inflammations of the lungs, or weakness of the heart, while the onset of coma or convulsions is a very grave sign.

Sometimes the onset is gradual, swelling and puffiness of the face first directing attention to the state of the urine.

Management.—Acute Bright's disease is always serious. The patient should be kept in bed, clothed with flannel. As the urine is scanty excretion is less than usual, and should therefore be supplemented by increased excretion by the bowels and the skin. The irritant in the blood also needs to be diluted as much as possible. The bowels, therefore, should be kept in a state of active purgation, while sweating is promoted by the use of hot bottles or hot baths or even vapour baths, at the same time giving plenty of hot fluids by the mouth to help wash out the poison. Every precaution must be taken to avoid draughts and chills. The urine should be carefully measured every twenty-four hours and the quantity noted on the chart; to do this the patient should be made to pass water before the bowels act. A specimen should be placed aside to be tested daily. A sharp look-out must be kept for any sign of undue drowsiness ushering in coma or for convulsions. The diet is of the simplest description; as a rule only milk is allowed, together with plenty of barley or rice water or imperial drink. As the albumin gets less, more farinaceous food can be given, but nitrogenous food is avoided so long as the albumin is present. Alcohol should be avoided unless ordered by the doctor.

During convalescence the patient suffers from

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anæmia and should avoid cold and damp for some months.

Chronic Bright's Disease is met with in two forms—

1. In which it is only a persistence of the acute inflammation in a mild form. Little more need be said about it except that there is great anæmia, a tendency for dropsy, vomiting and headache.
2. A disease of different nature altogether which comes on in people over forty, who have always lived hard, worked, eaten and drunk more than is good for them. This second form is often known as granular or gouty kidney.

The increased resistance of the flow of blood through the kidneys causes hypertrophy and increased action of the heart, and therefore a high tension pulse. This increase of blood pressure produces a very copious secretion of watery urine. The individual suffering from this form of the disease looks very different from the pale, puffy and pasty appearance of the patient suffering from the other. He is thin and has lost weight as a rule, his face is highly coloured from dilatation of the small vessels of the cheeks, he may suffer from headache, giddiness and shortness of breath, but dropsy is uncommon in the early stages. In this form death from rupture of one of the vessels of the brain (apoplexy) is not uncommon, owing to the increased blood pressure.

Management.—The same general rules must be attented to as are detailed for the acute form. The

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urine should be examined from time to time to see if the amount of albumin is diminishing or increasing. The bowels must be attended to and vapour or hot baths taken once or twice a week, after-chills being guarded against. The diet should be of the simplest description and the amount of meat curtailed as much as possible, plenty of non-alcoholic fluid should be taken. A warm, dry climate like Egypt suits these people much better than a cold damp one. In this disease alcohol should be forbidden, also all work involving undue strain, mental or muscular; the exercise should be regulated carefully so that increase in the blood pressure is prevented. Headache, palpitation, faintness or indigestion are all warnings which should be heeded.

Renal Colic is the pain experienced when a renal calculus which has formed in the pelvis of the kidney slips into the narrow part of the ureter, and there becomes fixed by the contractions of the tube, which attempt to pass the stone onwards into the bladder. If the stone is small it reaches the bladder in a few hours and the pain comes to an end. If the stone is too big to pass, the contractions become more and more forcible in their attempts to pass it on, and the pain increases proportionally, until the stone slips back into the renal pelvis. The character of the pain is peculiar, it comes on suddenly after some active movement, and starting in the loin of the affected side, radiates round to the front of the body and shoots down into the thighs and genitals; in the male the testis is violently retracted on that side.

The pain comes on in spasms, getting worse and worse to a point where the patient may be doubled

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and rolling on the floor, violently sick and sweating profusely, then subsiding for a time only to return later. In the intervals the patient lies exhausted in the utmost dread of the return of the pain. There is a constant desire to pass water and great straining to do so, but only a few drops at a time are passed and these often contain blood. This urine should be saved for examination, as blood and crystals of the stone may be present. After the stone escapes urine is passed freely.

Management.—Hot applications such as fomentations to the loin and abdomen and a very hot bath are useful, but in severe cases the doctor usually gives an injection of quarter to half grain of morphia, and sometimes chloroform may be needed to allay the agony.

Other Common Diseases of the Kidneys such as calculus, tubercle and tumours of the kidney have certain symptoms which are common to them all; the most common are—

1. Pain in the back of a dull aching nature, sometimes coming on in spasms of greater severity so as to assume the characters of renal colic.

2. Frequency of micturition, whereby the bladder is emptied more often than is normal owing to the irritation of the urinary tract. The bladder is usually emptied three to five times a day, but this varies with the amount drunk and with the weather. In hot weather and during exercise the skin perspires freely, while in cold weather and at rest more is excreted by the kidneys. As a rule there should be no occasion to empty the bladder during the night, but in old people, especially in men with enlargement of the prostate, the habit of rising once

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or twice during the night is usual. During pregnancy the same thing occurs in women, as the enlarged uterus presses on the bladder.

3. The urine often contains pus, blood, tumour cells and micro-organisms, and an examination may often clear up the diagnosis.

Movable Kidney.—This condition is more often found in women than in men, and the right kidney is much more frequently affected than the left. It is caused by an absorption of the fatty capsule which surrounds the organ and serves to keep it up in place. It is therefore usually found in thin people or those who have lost weight lately. Laxity of the abdominal muscles after the removal of tumours or the birth of a child is often a factor. As a result of the dropping downwards of the kidney the vessels and nerves of the organ are pulled upon, and a dragging pain is felt in the back whenever the person has been walking about for some time. Relief is experienced on lying down, as then the kidney can return to its normal position. Symptoms of indigestion, loss of appetite, pain after food, vomiting, are very common and may obscure the diagnosis. As the result of constant pain the patient often drifts into a highly nervous condition, is always thinking about her health, and if left unrelieved for a length of time may become a confirmed neurasthenic. A well-fitted belt supplied with a pad to support the kidney will often correct the condition and cure the symptoms. The belt should be applied in the morning before the kidney has slipped from its place, it should always be put on when the patient is lying down. If the condition is neglected, the tissues of the kidney may suffer

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from the ureter becoming kinked and obstructed and the pelvis of the kidney gradually becoming dilated. In severe cases an operation is sometimes needed in order to secure the kidney in its proper place.

Diabetes is a condition where the amount of urine excreted is greatly increased; it is not really due to disease of the kidneys, but to changes in the blood itself, due to disease in other organs.

It has been noted that all the starchs and sugars are absorbed as glucose, and carried to the liver where this is stored, only to be given out in small quantities to the blood as required. When this function of the liver is upset, the organ no longer stores it properly, and too much passes into the circulation. When the amount in the circulation exceeds a certain point the kidneys excrete it. The symptoms begin gradually, the attention being directed to the great thirst the patient experiences owing to the large amount of urine excreted. As a rule the patient finds he has to rise several times during the night to empty the bladder. The appetite increases and may be enormous, but all the time there is a steady loss of weight. The urine may be increased in quantity to more than a gallon a day. The colour is very pale, the specific gravity is above 120 as a rule, and may be 145. On testing the urine it is found to contain sugar and to reduce Fehling's solution.

The course of the disease is more rapid and fatal in young and thin people than in those over forty and stout. The amount of urine and the quantity of sugar it contains are indications of the severity of the disease. The fatal termination is often ushered

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in by drowsiness and coma. *Complications* which may occur are boils and carbuncles on the skin, inflammation of the nerves, pneumonia, albuminuria and lastly gangrene of the limbs.

Management consists largely in controlling the diet, which should consist of those substances which do not form sugar, so that all sugars and starchy foods are excluded as rigidly as possible. Unfortunately certain articles suitable for invalids contain these substances and are very difficult to replace, such as milk and bread, and therefore a certain laxity must be allowed or the patient will break from the control of a too-rigid dietary.

The following articles may be allowed—

Butcher's meat, poultry, game, and fish of all kinds, fresh, salted or cured, bacon, ham and cured meats. Unthickened soups made from these. Eggs cooked in various ways, cheese, butter, cream. Many forms of diabetic bread can now be procured, such as almond, bran and gluten bread. Well-toasted, thin slices of ordinary bread are usually allowed. Vegetables, small quantities of turnips, French beans, cabbage of all sorts, asparagus, seakale and marrow. Vinegar, olive oil and pickles, olives. Jellies flavoured but unsweetened, custard. For drink: tea, coffee and cocoa from nibs; no sugar may be taken, but saccharine may be used as a substitute. Dry sherry, claret, Sauterne, Burgundy, Chablis, Hock, brandy, whisky, soda-water.

To be avoided are—

Sugar in any form. Bread and biscuits, rice, arrowroot, cornflour, oatmeal, sago, tapioca, macaroni, vermicelli, potatoes, carrots, parsnips, beetroot,

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peas, onions. Pastry and all puddings. Fruit of all kinds, milk in large quantities. Sweet ales, port, stout, cider, sweet or sparkling wines, liquers.

As a rule a chart is kept on which the dietary is marked, together with the quantity of urine and the percentage of sugar passed, and the weight each week recorded. When placed upon a diet the quantity of urine diminishes, the percentage of sugar becomes less, and the weight increases and the health improves.

Sudden and unexplained rises in the amount of sugar passed usually mean that an unauthorised addition has been made surreptitiously to the diet. A strict diet is most irksome, and to some quite intolerable, even when its object is fully understood, while ignorant people in hospital will evade these restrictions whenever they can catch the nurse off her guard. Worry and anxiety must be avoided, exercise and fresh air are advisable, but fatigue must not be allowed, diabetics are easily tired.

The thirst can be assuaged by water or imperial drink. The most useful drugs are those derived from opium, especially codeine; cod-liver oil is useful as a food.

Operations must be avoided, as diabetics are peculiarly liable to sepsis, moreover the giving of chloroform or ether will often cause the onset of diabetic coma.

Diseases of the Urinary System

Retention of Urine.—This is usually brought to notice by the evident pain from which the patient suffers owing to the stretching of the bladder wall. In unconscious or dying people no sign may be given,

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and the nurse should be on the look-out for retention.

Retention often occurs after operations in the region of the rectum or genitals, and report should be made to the surgeon if the patient has not passed water within twelve hours.

In many cases a warm sponge or hot fomentation to the perineum may be followed by the flow of urine. Some people find it impossible to pass water in the dorsal position, but can pass water at once if allowed to turn on their side. In most cases, however, the water has to be drawn off with a catheter.

Suppression of Urine has been fully described in *Acute Nephritis*.

Incontinence of Urine may be of two varieties.

1. Where the sphincter does not act and the urine constantly dribbles away, the bladder always being empty.
2. Where the sphincter does act and the bladder gradually fills with urine which is discharged every six hours or so, the patient being quite unconscious of the action.

In either case some apparatus should be arranged so as to prevent the bed getting wet.

Retention with Overflow is a condition that may easily be missed. In this case the bladder fills with urine and from some reason or another cannot be emptied. When it is fully distended, a small quantity forces its way out through the contracted sphincter or other obstruction, so that it appears as if the person had incontinence.

If, however, the hand be placed over the lower

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part of the abdomen the distended bladder can be usually felt. Conditions in which it occur are: boys who have a small stone obstructing the urethra; women in the early months of pregnancy, or when suffering from hysteria; middle-aged men with stricture of the urethra; old men with enlarged prostates. It may happen to any one who has had an operation liable to give rise to retention. In recent cases the bladder should be emptied as in ordinary retention; in old-standing cases care is needed to draw off the water very slowly.

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CHAPTER XIV

THE SKIN AND DISEASES OF THE SKIN

The Skin

The Skin or covering of the body is composed of a superficial layer which is called the epithelium or cuticle and a deep layer the true skin or cutis vera.

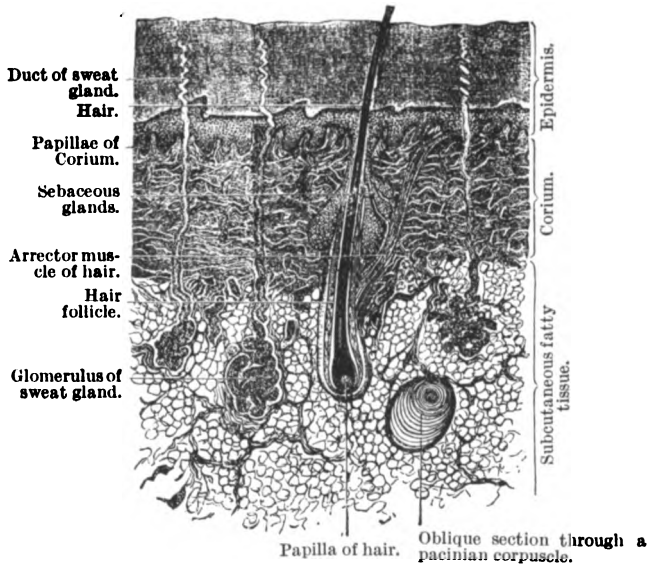

FIG. 42.—Vertical Section of the Skin (schematic).

The Epithelium is many layers thick and is composed of cells which are constantly being rubbed off from the surface and reproduced from the deeper

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cells. The deeper cells are more or less square in shape, but as they are pushed to the surface they become flattened until they end by becoming a dry scale-like structure. There are no blood-vessels or nerves in the epithelium.

The Cutis Vera is highly vascular. In places where the epithelium is especially thin the red colour of the true skin can be seen through, as in the cheeks and lips; if the vessels become engorged the skin appears bright red. The cutis vera is raised into ridges and papillæ which contain the delicate endings of the nerves of touch. If the skin is irritated acutely the process of inflammation starts (see *Inflammation*), the area becomes red, and later a blister forms. This blister forms between the true skin and the cuticle. In chronic irritation, such as pressure, the cuticle becomes extremely thick to protect the deeper parts. Hence the thick skin on the heel and the corns on the toes. When the cuticle is thick the skin is very insensitive as the terminations of the nerves are far from the surface.

Sweat Glands are long tubes which are coiled up in the deeper parts of the skin and open on the surface by their duct. They secrete the sweat, which consists chiefly of water, salt and a small amount of urea, the last-named being the impurity in the blood which is chiefly got rid of by the kidneys. If the kidneys become diseased free sweating eases them of a good deal of their work.

The Sebaceous Glands are much the same as the sweat glands, but secrete a fatty, oily fluid.

The Nails and Hair are both specialisations of the outer layer of the skin. The nails are formed of scales closely set in layers, and contain horny material

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which gives them the required hardness. The hair grows from a root embedded in the cutis vera and has a central soft pith which is covered by scale-like cells containing pigment to which it owes its shade of colour. In the white hair of old people the pigment is lacking.

Functions of the Skin are—

1. Protection. By its excessive toughness it protects the underlying tissues.
2. Heat regulation, this is most important. (See Chap. XVIII.)
3. Excretion. By means of sweat a good deal of the waste products of the blood can be got rid of. (See *Kidney Disease.*)
4. Respiration. } Both these are unimportant
5. Absorption. } functions, though absorption of oily materials goes on fairly rapidly. For instance, children who cannot take cod-liver oil by the mouth can be dosed by rubbing it into the skin. Many ointments are also absorbed if rubbed in the skin.

Diseases of the Skin

Erythema is the name given to a mild inflammatory redness of the skin which may be caused by scorching by the sun, by cold in chilblains, or by any irritating substances used as counter-irritants. It is usually associated by swelling of the part, heat and an itching sensation which prompts the person to scratch or rub the part, doing so, however, is painful. To relieve the tenderness a cold, wet poultice can be applied or some mild ointment such as boracic ointment, and the part protected from

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rubbing. The redness soon passes off and later the cuticle peels off in thin flakes.

Nettle-rash or Urticaria, so-called from its resemblance to the rash produced by the sting of a nettle, which is a raised white blotch on a red ground. The rash may be caused by irritation of rough flannel, mental emotion, indigestion, shell-fish such as mussels, cockles, scollops and oysters, certain drugs may also cause it, particularly the oleo-resins such as copaiba and sandal wood oil. The rash may be local or general, and is accompanied by intolerable itching, worse at night, and may be so bad as to prevent sleep.

Management.—Luckily the condition does not last more than a day or two. The cause must be removed, the irritating garment put aside, and the emotions calmed. If it is due to indiscretion in diet a brisk purge should be given to stop further absorption, while lead lotion or dusting powder may be applied to relieve the itching.

Eczema is an inflammatory eruption of the skin in which there are shiny, raw-looking areas, moist with a constant exudation, which if allowed to dry will form crusts adhering to the part, if it dries on the linen this becomes stiff. Sometimes this is called weeping eczema to distinguish it from the dry form in which moisture is absent, the inflamed part being covered by dry scales.

Soreness and itching may accompany either form, and extensive areas and even the whole body may be attacked. It is extremely common in neglected infants, appearing in the folds of the groin, axillæ, and behind the ears, from the irritation caused by the two unwashed skin surfaces lying together.

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This form is often known as intertrigo. Ordinary cleanliness and dusting powder will prevent its onset. Eczema is common also in children of the poorer classes from the irritation caused by lice and dirty linen.

Management consists in removing the irritation if this can be found. If scabs are present ointments are useless till these have been removed. Sometimes they are very difficult to remove especially if they are on the scalp and hair is incorporated in them. The best way to remove them is to soak flannel in a solution of hot water and washing soda and apply this in the form of fomentation to the part, the flannel is covered with a mackintosh. In the most obstinate cases twelve, twenty-four or thirty-six hours will have sufficed to remove or soften all the scabs. The softened ones can then be detached, and the hair cut. Another very similar and even more efficacious application is a starch poultice (see Appendix). The part should be well washed periodically with warm water and soft soap—hard soaps often irritate inflamed skins.

Once the part is clean ointments can be applied. In bad cases the ointment should be applied on lint and applied in strips which are kept in position by a bandage. One of the best ointments is Ung. Hydrag. Ammon. diluted to half strength with lanoline.

Lotions may be applied on linen and covered with oilsilk or mackintosh, which should extend well over the margin of the linen so as to prevent evaporation. Oils and preparations of tar may be applied with a brush. As soon as the exudation has stopped the part should be dusted well with boracic acid and starch. Precautions are necessary to prevent

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children scratching and rubbing the place; their hands are best tied in soft cloth bags at night.

Psoriasis is a very chronic scaly condition of the skin affecting the back of the elbows and forearms and the front of the knees and legs. The skin is rough to touch and dirty white in colour, from the thickening of the cuticle which is shed as white scales.

Herpes or Shingles is a vesicular eruption appearing as small groups of vesicles with clear contents; these rapidly dry up, and form scales which later fall off. Herpes labialis is the form which often appears on the lips or about the mouth during pneumonia and lung conditions.

Herpes Zoster appears over larger areas, usually picking out the distribution of a nerve, so that it may be found extending all round one or both sides of the body. This form may be preceded by severe neuralgic pains which passes off after the appearance of the rash; especially is this the case if the forehead is affected over the area of the frontal nerve. If the vesicles are allowed to become septic, pit-like scars resembling smallpox may be left, for this reason it is wise to protect the vesicles when they appear on the face by painting them with collodion.

Parasites

Lice or Pediculi will live on the bodies of unwashed people. Lice are small insects of a yellowish brown colour and rather difficult to see. They are of three varieties. One, the pediculus capitis, lives upon the head and attaches its eggs to the side of the hairs close to the scalp, these hatch out in a few days, but the eggs or nits as they are called

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remain attached to the hair and are easily seen for a long time. Another variety lives among the hairs of the pubis, axilla and eyelashes, it is called pediculus pubis and its habit of laying its eggs is similar to the preceding. The third, the pediculus vestimentorum, lives on the body and lays its eggs along the seams of the clothes where also the insects themselves can be found hiding.

These lice live by biting the skin and their bites cause a rash-like appearance on the skin. They cause much itching and therefore the skin is scratched and made sore. The irritation of their bites and scratching often causes eczema and pustular sores to form. The glands in the neighbourhood enlarge and frequently suppurate.

Head-lice are extraordinarily prevalent among children of the poorer classes in whom little attention is paid to the condition of the hair. Soldiers on campaign, where cleanliness is not possible, rapidly become infected with body lice.

Management.—These animals cannot live where the ordinary rules of cleanliness are observed. They are easily killed by any antiseptics. When nits are seen in the hair of a child, the mother should be told to use a small tooth-comb and ordered to run over the scalp each night a solution of 1 in 2000 perchloride, or 1 in 60 carbolic. The old nits are very difficult to detach from the hair, but they are quite harmless, as they have hatched long ago. Another method of dealing with the lice is to rub in any antiseptic ointment. Pediculi pubis are dealt with in the same way. Paraffin will also kill lice, but should never be applied to children's heads on account of the danger from open fires. Pediculi

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vestimentorum are more difficult to get rid of, as they will live for a long time in blankets and clothing. If possible all the clothing should be sent to the steriliser or put in the oven and submitted to heat. If this is not possible it should be washed and soaked in an antiseptic, or sprayed with an antiseptic such as formalin and then aired.

Scabies or the Itch is a contagious disease, due to a small insect which burrows into the skin and there lays its eggs. It sets up a great deal of irritation, especially at night, so that the skin is scratched and the insect carried from one part to another. A small pustule forms over the burrow, and scabbing is not uncommon. The parts of the body usually afflicted are between the fingers and round the wrists, but the whole of the body, except between the shoulders, where it is difficult to scratch, may be affected. The face usually escapes. The disease is easily conveyed from one person to another either by using the same bed or by exchanging clothes.

Management.—A hot bath should be taken and the whole body well soaped. The person should then soak himself in a hot bath to which an ounce of sublimed sulphur has been added. This penetrates the skin and destroys the insects. The skin should then be well rubbed with a weak sulphur ointment, the ordinary sulphur ointment diluted with lanoline is best. This fills up the burrows and destroys any insects which hatch out later. Fresh clothes are worn next day, and the old ones, including the bed linen, soaked for the night in antiseptics (1 in 2000 perchloride or 1 in 60 carbolic) or the clothes can be baked in the oven. If this is repeated for

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three or four days the person will, as a rule, be perfectly free from the insects. In children the sulphur ointment itself may cause irritation of the skin, which may give rise to the idea that the insect is still present.

Ringworm or Tinea is a vegetable parasite which is contagious and easily conveyed from person to person. There are two great varieties, the one T. Tonsurans, which attacks the hairs of the head, and the other, T. Circinata, which attacks the skin of the face and body.

T. Tonsurans causes hairless patches to appear in the scalp and these if examined will be found to be covered by short, brittle hairs which have broken off short. If the hair round about is infected, it can be pulled off in tufts.

T. Circinata causes small red rings to appear on the skin, the surface of which is covered with a fine scurf. The ring has a pink edge and gradually spreads at the margin.

Management.—In both cases the parasite has to be destroyed. In the case of T. Circinata the patch may be painted with tincture of iodine or pure carbolic acid applied with a brush, the excess being carefully dried off. White precipitate ointment is then smeared over. One application in this manner is usually sufficient. In the case of T. Tonsurans the matter is more difficult, especially once it has secured a good hold. The hair must be cut short for a good inch beyond the region where the hair is brittle. The skin is then washed and dried and pure carbolic acid painted on, or a lotion of acetic acid or sulphurous acid applied on lint and covered with oilcloth, white precipitate ointment being rubbed

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in afterwards. Constant care and repeated applications may be required for weeks before a cure is affected. Lately the X-rays have been used with great success. Children should be kept from school when affected and the general health carefully attended to.

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CHAPTER XV

BANDAGING AND SPECIAL FORMS OF BANDAGING

Bandaging

BANDAGING is used in many circumstances for different purposes, but chiefly to give rest and support to a limb, to arrest hæmorrhage, to retain dressings and splints in position, and to check and cure swelling of a part.

The *Principles of Bandaging* must be understood if the bandage is to perform its office successfully with comfort to the patient. Practice alone will give proficiency and the reader should apply the bandage as the directions are read.

Two forms of bandage are in use, the roller and the triangular handkerchief. The former is usually used in hospitals and medical practice, as they are kept prepared in readiness; the latter are, however, more easily procured in emergency, so their study will repay the reader.

The Roller Bandage is usually 6 yards long, and may be of various widths from 1½ to 8 inches, but 2½, 3 and 4 inches are the widths most commonly used. Practice should be conducted with a 3-inch calico bandage. Narrow bandages can easily be made by cutting a piece off a broad bandage with a sharp knife.

To prepare bandages a piece of calico 6 yards

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long and about a yard wide is taken and the selvages torn off. Short snips are made with scissors at one end 3 inches apart, and each one is torn down for a short distance till the whole width has been used. Two people then take every other strip, and on pulling them apart the whole length of the calico will be torn into strips 6 yards long and 3 inches wide. Each strip must then be rolled into a bandage. If this is to be done by hand, one end is folded over tightly till a small roll is made; this is then laid on a flat surface such as a table, or it can be done on the front of the thigh, and the fingers and palm of the right hand passed firmly over the roll, which will run along winding itself up. This manœuvre is repeated again and again till the bandage is completely rolled. If a winding machine is used the first few turns are made tightly round the centre pin, the handle is then turned with the right hand, while the left feeds in the bandage, keeping up steady tension. When all is wound, the bandage is grasped and a few turns of the handle given in a reverse direction, and the centre pin withdrawn. The end of the bandage should be fixed with a safety-pin, which will be useful when the bandage is used. In applying the bandage the roll is known as the head, the loose end as the tail, the surface which is against the limb is the back of the bandage, the exposed surface the front, there is also an upper and a lower margin. Limbs are not straight cylinders of even thickness, or bandaging would be quite easy, they are made up of blunted cones, which join each other by their apices or bases, with only here and there a short cylindrical portion. A calico bandage will lie flat over a cylinder, but if kept flat over a cone

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it will wander up, leaving parts uncovered, so that reverses and figure-of-8's have to be resorted to in order that these deficiencies may be covered in.

The following rules should be carefully observed—

1. Fix the bandage firmly, but not in such a way as to embarrass the circulation, a figure-of-8 does this excellently.
2. Bandage from below upwards, so as to help the circulation, and from within outwards over the front of the limb. This last injunction is merely for the sake of uniformity.
3. Use equable pressure throughout.
4. Let each succeeding turn overlap two-thirds of its predecessor.
5. Keep all the margins parallel, and let the crossings and reversings be in line, and rather towards the outer aspect of the limb, so as to give a neat appearance.
6. Fix the end of the bandage securely.

To these rules three others of the utmost importance must be added.

7. Skin surfaces should never be bandaged in contact with one another, as the secretion of the skin will cause irritation and ulceration. Lint or wool well powdered with boracic acid should always be laid between such surfaces to keep them apart.
8. Never flex a joint which has been bandaged in the extended position. If it is wished to keep the limb in a bent position afterwards it must be bandaged in that position. If it is bent after bandaging, the circulation will

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assuredly be interfered with, and gangrene may be the result. Students of bandaging should have their elbows bandaged firmly in an extended position, and then the elbow joint flexed and the arm put in a sling: They will never forget the experience. Try it!

9. If the greater part of the limb is bandaged after an injury, the fingers or toes should always be open to inspection, so that swelling or blueness can be noticed at once. An injured limb may swell *after* the bandage has been applied, the bandage will then become too tight, and the circulation suffer. This will be shown by blueness and œdema of the digits, which is a warning that the bandage is too tight, and can never be disregarded; the bandage must be loosened at once. This is especially the case in children and old people, where the circulation is feeble.

The application of bandages should be practised as follows—

1. **To Bandage the Hand.**—For practice, the back of the hand should be towards the operator, with the fingers extended and separated by pieces of wool. The operator stands in front of the hand, a fixing figure-of-8 turn is made by laying the tail of the bandage along the second phalanx of the forefinger, rolling it round the wrist, descending to terminal phalanx of the little finger and so round to the starting-point. The next turn passes across the fingers. The third turn will tend to wander up

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the limb, which here is cone-shaped, it is therefore necessary to employ a reverse. To make a reverse unroll about three inches of the head, steady the lower margin of the bandage by laying the left forefinger on the front of the bandage to the outer side of the middle line, twist the right hand over so that the back of the bandage appears over the left forefinger, and draw the fold so made firmly round

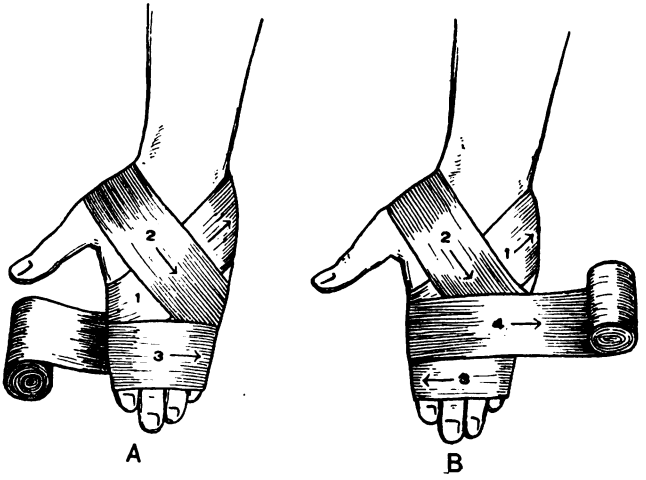

FIG. 43.—Hand Bandages.

the side of the little finger. The head of the bandage no longer unrolls naturally, but has to be unwound as it is passed from the right to the left hand under the limb, and is then given again to the right hand to make the next turn. This turn will also tend to wander upwards, and the reverse has to be repeated, and the front of the bandage again appears, and the head will again unroll naturally.

In this manner the hand, with the exception of

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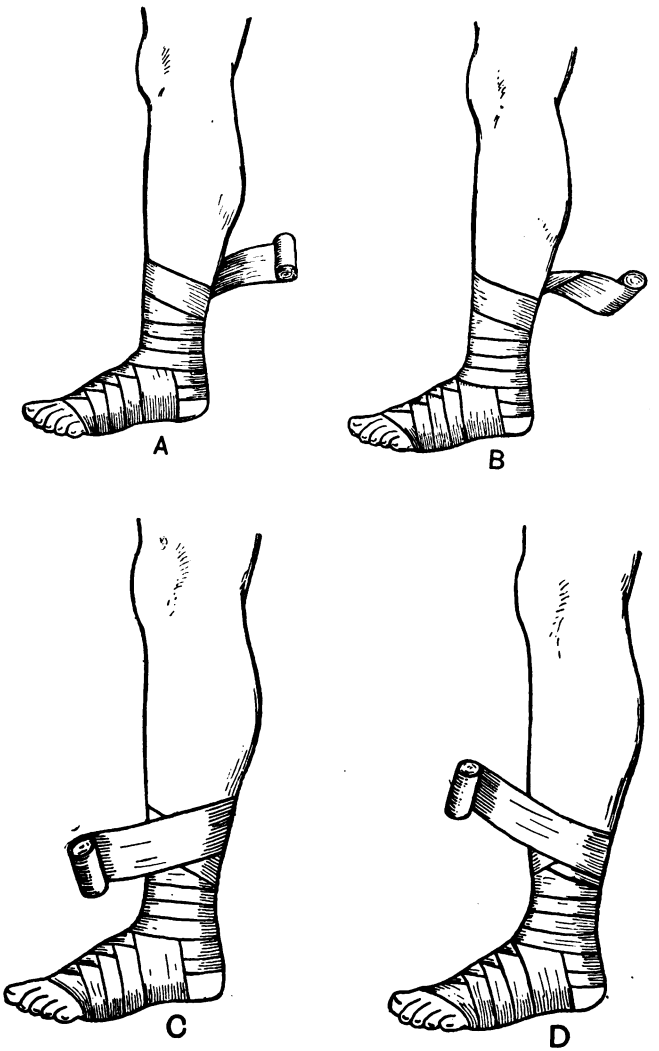

FIG. 44.—Leg Bandages.

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the thumb, is gradually covered in. As the wrist is approached, the limb becomes narrow, and a figure-of-8 turn will be needed to make the bandage lie flat.

Note.—When bandaging left limbs, manipulations are chiefly carried out with the right hand; in the case of the right limb the left hand is employed and the task is at first more difficult.

2. **The Foot** is bandaged in the same way as the hand. The tail of the bandage is placed opposite

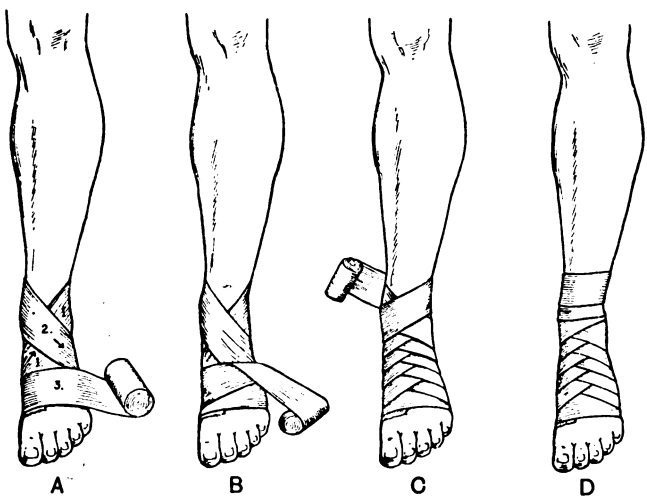

FIG. 45.—Foot Bandages.

the ball of the great toe, and the roller carried round the outer side, back and inner side of the ankle, across the foot to the outer side of the little toe, and under the sole to the starting-point. A transverse turn is then made across the roots of the toes, and a second turn is commenced in the same way, the bandage now shows a tendency to wander up the foot, and a reverse must be made by steadying

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the lower border with the left forefinger or thumb, while the twist is given with the right hand and the bandage brought back to its place. Successive turns and reverses are given, each covering in two-thirds of the preceeding turn, till the ankle is reached. The heel can be left out for the moment, and the bandage proceed up the leg. Above the ankle several simple spiral turns can be made until the bandage begins to wander away up the leg, when reverses will have to be made to keep it in its place.

3. **The Heel** can be covered in by a looped bandage. Having covered in the forepart of the

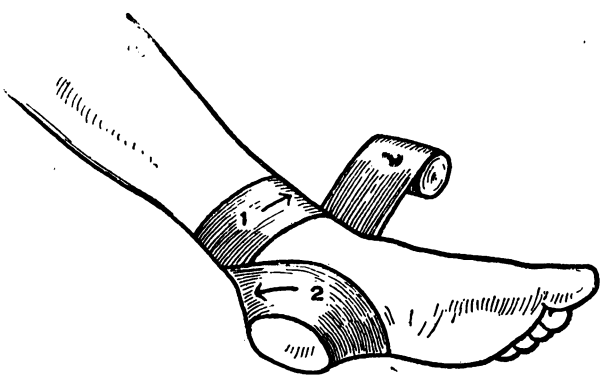

FIG. 46A.—Heel Bandage.

foot as far as the ankle in the manner described, the bandage is carried from the inner side of the ankle to the outer side of the foot, under the side, and looped round the heel to the tendo calcaneus and the outer side of the ankle, whence it passes to the inner side of the instep under the sole and loops round the heel in the opposite direction. Several such loops can be made before the bandage proceeds

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up the leg. The point of the heel still remains uncovered. A spica bandage can be used to cover it in completely, see Fig. B, p. 207.

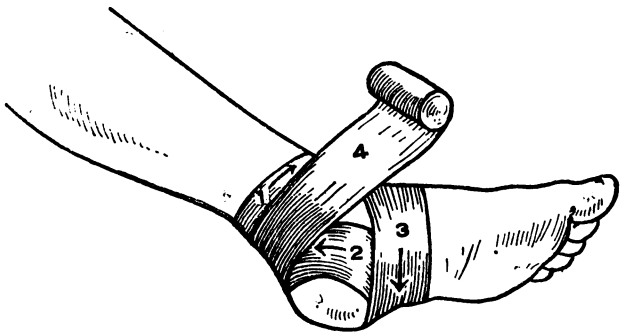

FIG. 46B.—Heel Bandage.

4. **To Bandage the Closed Fist** a series of figure-of-8 turns are needed. A bandage should be placed in the palm of the hand over which the

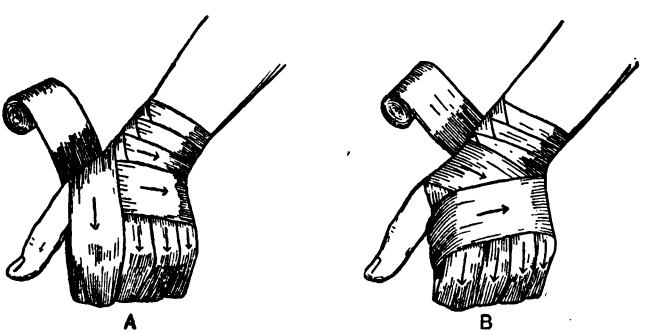

FIG. 47.—Fist Bandage.

fingers are closed, cotton-wool should separate the skin surfaces of the fingers. A fixing turn is placed round the wrist, the bandage is then carried obliquely across the back of the hand to the knuckle of the

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little finger, which it overlaps freely, and then passes back to the thumb side of the wrist round which it circles, completing the figure-of-8. The next turns cover the knuckles of the ring and middle fingers, encircling the wrist between each. The bandage then overlaps the knuckle of the forefinger back to the wrist and then passes across the dorsum of the hand binding in the part of the bandage lying free of the little finger, and under the clenched fingers to bind in the part overlapping the forefinger, and then takes a final turn round the wrist.

5. **A Looped and Reversed Bandage** can be used for the leg or forearm. It is the best bandage to give support to the leg in a case of varicose veins, though of late the use of elastic bandages has caused it to be less used than formerly. We can suppose the right foot has already been covered in, and that a few spiral turns have been made above the ankle and the bandage is beginning to wander up the leg. Instead of making the ordinary reverse on the front of the leg the bandage is taken to the back of the leg, and changed as usual to the left hand, the right hand steadies the lower margin, while a reverse is made with the left hand, and the bandage brought down and round the limb over the last turn and serving to fix it firmly. It then passes across the back of the limb and now begins to wander up again, when it is again reversed back into place to loop over the front part of the turn. Succeeding loops are thus made all up the limb, giving the appearance of reverses both in front and behind. As each loop is fixed by the next the bandage gives great support and will not slip when walking.

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Special Forms of Bandage

The Spica.—This is simply a special form of a figure-of-8; the term is taken from its supposed resemblance to a spikelet of wheat. It is used to cover prominences such as the heel, elbow and knee.

1. *The Divergent Spica for the Heel.*—The tail of the bandage is laid against the external malleolus,

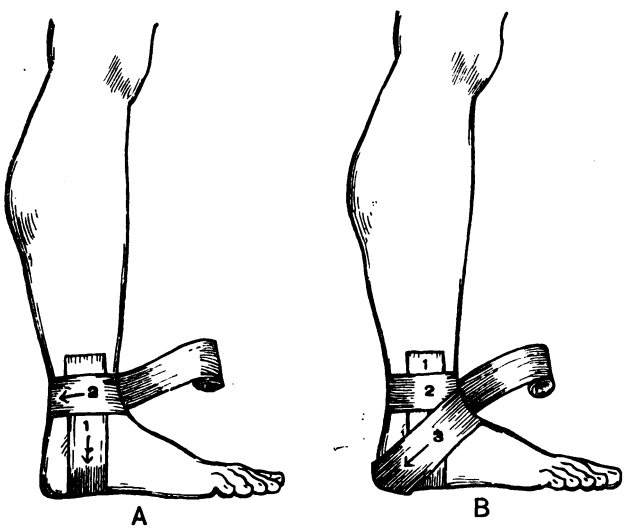

FIG. 48.—Divergent Spica for Heel.

and a fixing turn made by carrying the bandage under the sole and then round the ankle. The first turn of the spica is made to pass over the prominence of the heel back to the front of the ankle. Only the middle of the bandage will lie properly over the heel, the upper and lower margins being loose. The next turn covers the lower loose margin of its predecessor, the third covers the upper

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loose margin of the first turn, so that only the middle third of the original heel turn is exposed. The following turns cover in alternately the lower and the upper parts of the previous turns till the heel is well covered. The bandage then proceeds up the leg in the usual manner.

2. *The Divergent Spica for the Knee.*—The knee joint is slightly flexed. The tail is placed over the internal condyle and the head carried over the front

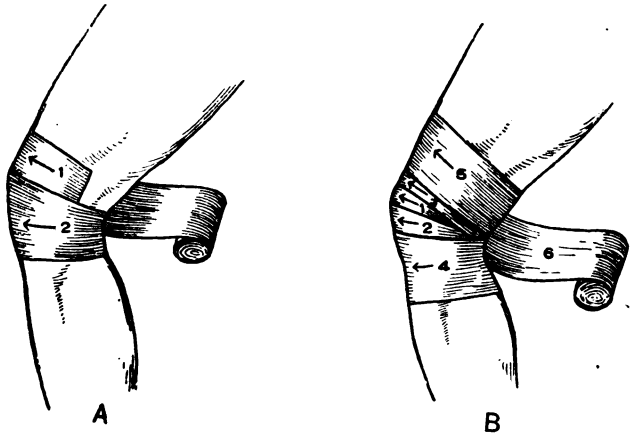

FIG. 49.—Divergent Spica for Knee.

of the patella round the joint to the starting-point. The succeeding turns pass round in a similar manner alternately above and below the first, covering in two-thirds of the turn they lie upon, until the whole joint is covered. This is a very good supporting bandage for the knee, its chief strength lying at either side. The bandage allows a certain amount of movement to take place at the joint in walking, the layers gliding slightly over each other.

3. *Divergent Spica for the Elbow* is applied in

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exactly the same manner as for the knee, but is not often used.

4. *The Ascending Spica for the Groin.*—This is used to control an inguinal hernia or to fix dressings after an operation for cure of hernia. The tail is placed over the inguinal region of the affected side and the roll carried upwards and outwards round the back of the pelvis, mid-way between the great

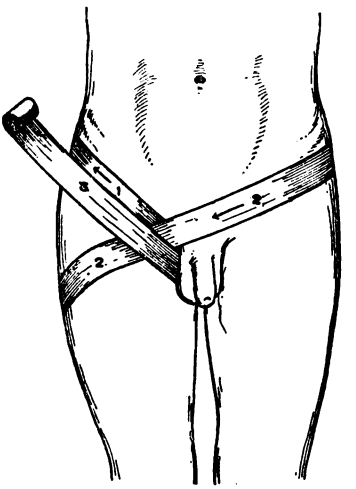

FIG. 50.—Ascending Spica for Groin.

trochanter and the crest of the ilium, and then downwards across the front of the body to the starting-point. From here the second loop continues downwards over and round the thigh to the perineum, and upwards again to the inguinal region, thus completing the figure-of-8. The next figure-of-8 turns are made in exactly the same way, but each at a slightly *higher* level, until the whole inguinal region is supported. To control a hernia

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a small flat pad of lint should be placed under each succeeding crossing, so as to exert more pressure on the canal and rings.

5. *The Descending Spica for the Groin* is preferred for cases of femoral hernia. The tail of the bandage is laid over the saphenous opening, and the roll carried over the front of the symphysis round the pelvis, mid-way between the great trochanter and

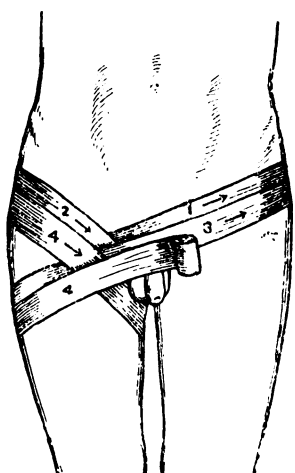

FIG. 51.—Descending Spica for Groin.

the crest of the ilium as before. The bandage is then continued down over the starting-point into the perineum and round the back of the thigh again to the starting-point, completing the figure-of-8. The succeeding turns are each passed at a slightly *lower* level, flat pads being placed at the crossings to increase the pressure over the hernia. In each of these bandages the pressure is applied in the direction in which the hernia must go back; from

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below upwards in the first and from above downwards in the second.

6. *The Double Spica for the Groin* is sometimes used when operations have been performed on both sides. Three crossings are produced, one on each

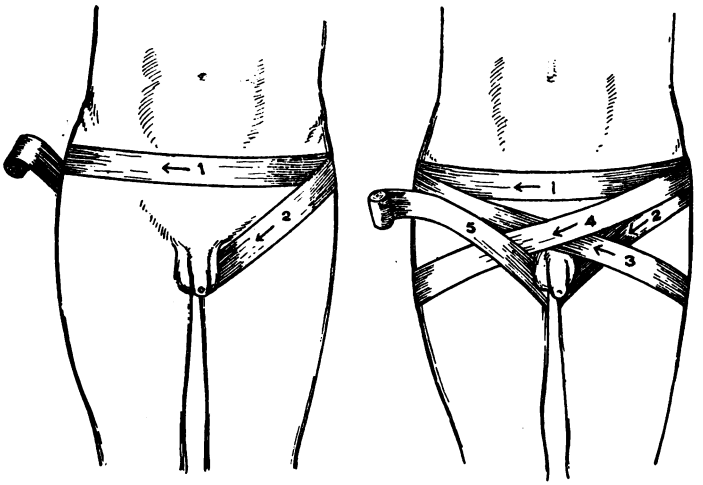

FIG. 52.—Double Spica for Groin.

side and one in the middle line. The diagram explains itself.

7. *The Spica for the Shoulder* is a continuation upwards of the bandage for the arm. The bandage is passed from the upper limit of the arm across the back, under the opposite axilla, and returns across the chest to the top of the shoulder, from here it takes a turn round the arm and axilla, and the figure-of-8 is completed. A series of figure-of-8's are made, the larger loop being round the chest and the smaller round the arm or shoulder, each passing a little higher than the last, till the whole

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shoulder is covered in. The larger loop must not be passed round the neck, as movements of the head and neck would soon loosen and displace the bandage.

8. *Single Spica for the Mamma* is used to support one breast. The tail is laid under the breast to be supported, and the roll carried round the body for fixation. The breast is then lifted up, and the bandage carried from below upwards to the opposite

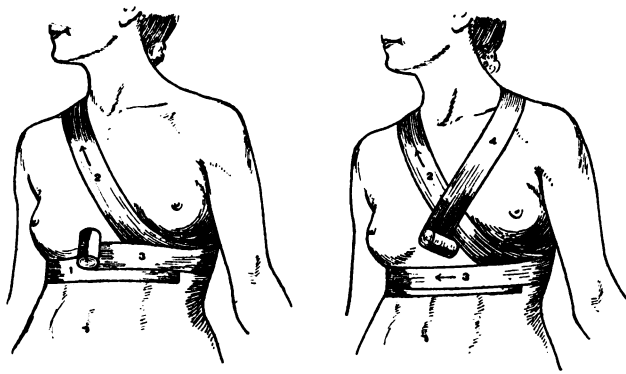

FIG. 53.—Bandage to Support Breast.

shoulder and obliquely down the back to the starting-point, completing the figure-of-8. Each succeeding turn both round the body and across the chest is slightly higher than the last, till the breast is quite controlled.

9. *Double Spica for the Mamma* may be used to support both breasts, and is very like the double spica for the groin. The bandage being passed under one breast from below upwards and under the other from above downwards, crossing in front and behind.

10. *The Spica Bandage for the Head* is most

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commonly used to fix dressings to the scalp. Owing to the circular shape of the head the loops of the bandage are liable to slip and become loose, it is necessary, therefore, that the fixing and concluding turns should be firmly applied. Three series of loops at right angles to each other are employed—

1. One horizontal in direction, passing above the level of the ears, grips the cranium over the forehead in front, and below the protuberance of the occiput behind.
2. A second runs from the vertex to below the chin, usually passing behind the ears.
3. A third and final turn passes from behind forwards, and serves to keep the other two in place.

To Bandage the Forepart of the Head the bandage is carried horizontally round the head, the tail is

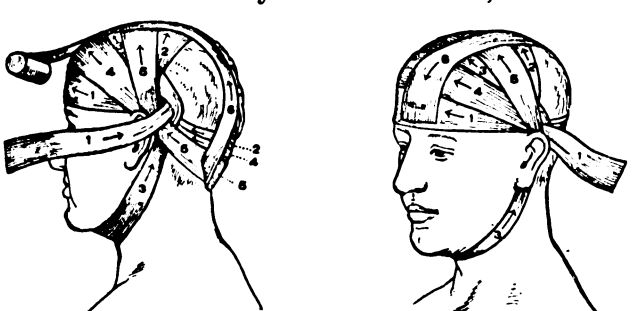

Fig. 54.—Forepart of Head Bandage.

left long and is held in the left hand. The roll is then carried from under the tail at right angles to the first turn over the vertex and under the chin. This divides the scalp into two halves, either of which may be covered in. The next turn passing

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behind the last subdivides the anterior half, and is carried round the back of the head, and the succeeding turns are applied as a divergent spica till the whole surface is covered in, the more horizontal loops passing round the back of the head, the more vertical ones under the chin. The bandage is finally fixed at the back with a pin, and carried forward in the middle line to end by being pinned in front, additional pins being used to fix the intermediate turns to this last and final one.

To Bandage the Back of the Head a similar bandage may be used, but is more difficult to apply.

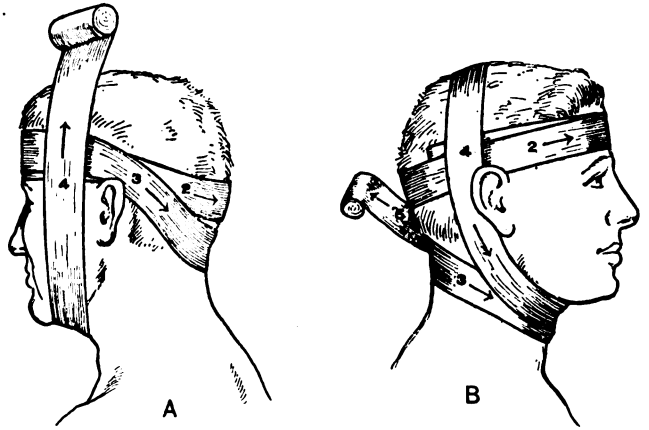

FIG. 55.—Bandage for Back of Head.

Another method, which is rather better, is to use figure-of-8 loops which are horizontal and oblique in direction. The vertical turn will pass in front of one ear and behind the other.

To Bandage the whole Scalp what is known as the *Capeline* bandage is sometimes used. Two roller

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bandages are fastened together by their tails and then part of one bandage is rolled on to the other so that one becomes longer than the other. The larger roll makes the horizontal turns and serves to fix the vertical turns made by the small roll.

The patient sits while the operator stands behind him with the larger roll in the left hand. The bandage is laid flat over the forehead, and passed round the sides to the back of the head, where the

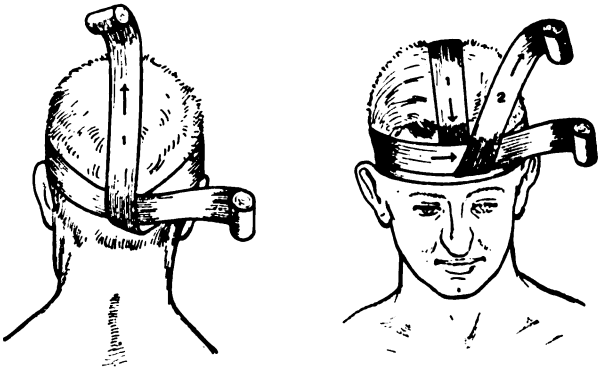

FIG. 56.—Capeline Bandage.

rolls are made to cross, the larger roll passing behind the lesser. The bandages must now be changed to the other hands. The larger roll continues round the head, while the other passes from the back over the top of the head to the front, where it is fixed by the horizontal turn; it then returns to the back, a little to one side, and is fixed again behind. Passes are made from front to back and vice versa, first on one side then on the other, each pass being fixed in front and behind with the horizontal roller till the whole scalp is covered. A very firm bandage is thus applied. The horizontal

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turns must not be made too tightly, or they will constrict the blood supply and cause headache. The bandage is difficult to apply and is seldom used, a triangular handkerchief is handier.

A somewhat similar bandage can be applied with a single bandage if one has assistance. A horizontal fixing turn is passed, and then a divergent spica applied to the vertex, each turn being fixed in

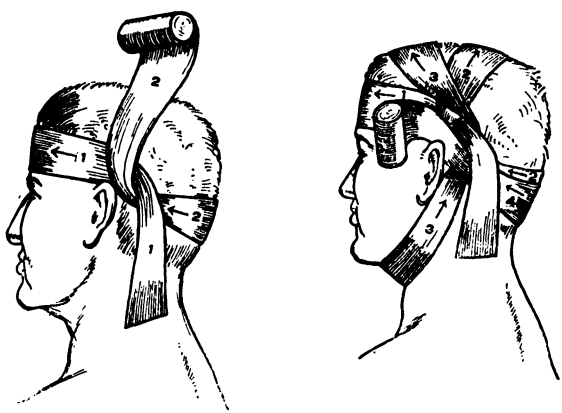

FIG. 57.—Another Head Bandage.

front and behind by the fingers of an assistant, a couple of horizontal turns are then made to hold the vertical turns in place. Safety-pins or needle and thread are used to fasten all securely.

11. *An Amputation Stump* can be bandaged with a single roller in the same way, the fingers and the thumb being used to secure the turns over the end of the stump in front and behind the limb. Circular turns and pins hold all in place. If the stump is short two or three figure-of-8 turns should be made round the trunk to prevent slipping.

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12. *How to Bandage the Eye,* see Fig. 58.

13. *To Bandage the Perineum.*—To keep dressings in place or support the scrotum, a looped bandage is used, called the St. Andrew's Cross. The bandage is fixed by encircling the pelvis from left to right across the front midway between the crest of the pubis and the anterior superior iliac spine. The bandage is then carried across the left groin down into the perineum and across the

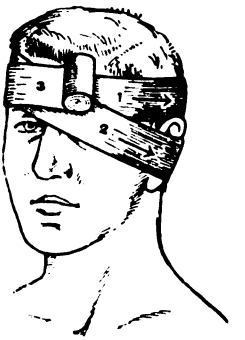

Fig. 58.

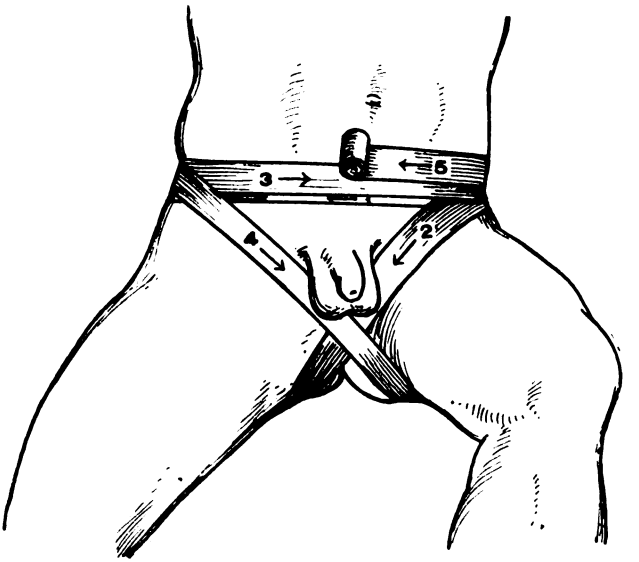

Fig. 59.—Bandage for Perineum.

right buttock. It then sweeps round the pelvis in the reversed direction, and crossing the right groin

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passes into the perineum, crossing the previous perineal turn, and passes up over the left buttock to where the bandage first started. Other loops are then added till firmness is obtained.

14. *The "T-" or Three-tailed Bandage* is often used to support dressings after operations on the perineum and anus. To make it, a three-inch bandage is taken and two pieces about a yard and a half long are cut off. The end of one piece is doubled over the middle of the other and sewn in place, the former is the vertical and the latter the horizontal portion. The horizontal portion goes round the waist and the vertical one passes under the perineum, the front part should be slit and then torn into two ends, passing one on each side of the scrotum and knotted off to the horizontal piece.

15. *The Four-tailed Bandage* is described in dealing with fractures of the jaw.

16. *The Many-tailed Bandage* is a most useful appliance to support a part or fix dressings with

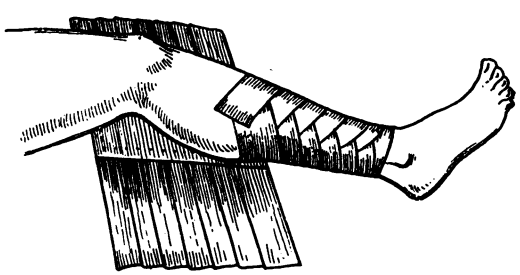

FIG. 60.—Many-tailed Bandage.

the least possible disturbance. It is used sometimes for the knee joint, but is most often used for the abdomen. For the limb a central strip or backbone is made of the required length, and to this some

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twelve overlapping strips are stitched at right angles, they should be long enough to go three-quarters of the way round the part. To apply it the limb is laid along the backbone and the two lowest tails are laid one across the other over the front of the limb, the next two fix the preceding ones in place and so on till all are used, when pins attach the last tails to the underlying ones. By taking out the pins and throwing the tails right and left the bandage is removed, fresh dressings are applied, and the tails folded anew without the limb being moved.

For the Abdomen the bandage is made of flannel in much the same fashion. The backbone of the bandage should be about six inches wide, and should project down below the bandages to take the part of the vertical strip in the T-bandage. The transverse strips should be four inches wide and four in number, and about one and a half yards long (in stout people they must be longer); they overlap each other slightly, and are basted to the backbone of the bandage.

The tails are folded up to the central strip, and the patient rolled slightly on one side while the bandage is pushed in under him as far as the middle line, one set of tails are smoothed out, and the ends of the backbone placed below the buttocks. He is then rolled over the opposite direction and the other set of tails unrolled and smoothed. The bandage should not lie in wrinkles against the back. The lowest tails are brought forward and crossed over the dressings, the others follow. When all are in place pins are inserted, and the vertical strip from the backbone is brought forward between the thighs, split down

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the middle, and pinned to the front part to prevent the bandage riding upwards.

For the Chest the many-tail, as prepared for the abdomen, can be applied with advantage. It should be put on upside down, and the vertical strips brought over the shoulders and fastened to the bandage in front to keep all in place.

Triangular Bandage

The triangular bandage is more readily improvised than the roller, and is, therefore, very largely used in military and emergency work, while in hospital practice it finds constant use in the various forms of slings to support the arm.

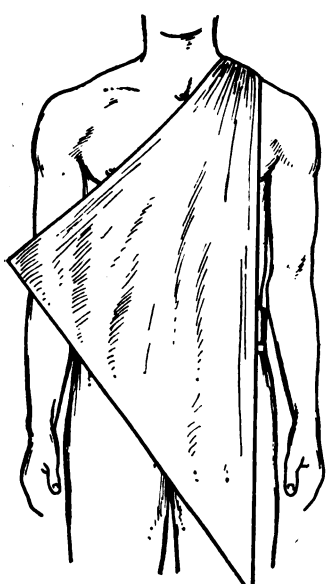

FIG. 61.—Triangular Bandage.

Description. — Triangular handkerchiefs are made by cutting pieces of calico or linen thirty-eight inches square diagonally into halves; each half forms a triangular bandage. Of the three corners the right angle is called the point, while the other two angles are called the ends. The long side is called the lower border and the others the side borders. To fold the bandage the two ends should be placed together, the ends and the point are then

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brought down to the centre of the lower border, thus forming a square. This is folded once from side to side, and twice from above downwards. The ends of the bandage should always be tied with a reef and not a granny knot.

The triangular handkerchief is used in three forms: (1) a whole-cloth, (2) broad-fold, and (3) narrow-fold. The broad-fold is made from the whole-cloth by carrying the point to the centre of the lower border, and then folding the bandage again in the same direction. The narrow-fold is made by folding the broad-fold once lengthwise.

Application of the Bandage.

1. *To Bandage the Top of the Head.*—Take a whole-cloth, lay it on the top of the head, with centre of the lower border over the forehead just above the eyebrows, the point over the back of the head. Fold in the edge, pass the ends round above the ears, cross behind over the point, and bring them round again to knot off in front. Place the hand on the top of the head to steady the dressing, and pull firmly on the point so that pressure is made on the dressing, then turn it up and pin off on the top.

2. *Side of the Head.*—Place the centre of a narrow-fold over the dressing, pass the ends horizontally round the head, cross and knot off firmly over the dressing.

3. *One Eye.*—Place the centre of a narrow-fold over the injured eye, pass one end obliquely up over the forehead, the other downward across the ear; cross below the occiput, and knot off above the eyebrow on the injured side.

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4. *Both Eyes.*—Place the centre of a narrow-fold between the eyes, carry the ends back, cross behind and knot in front.

5. *Chin and Side of Face.*—Place the centre of a narrow-fold under the chin, pass the ends upwards, and knot off on top of the head, tucking in the ends.

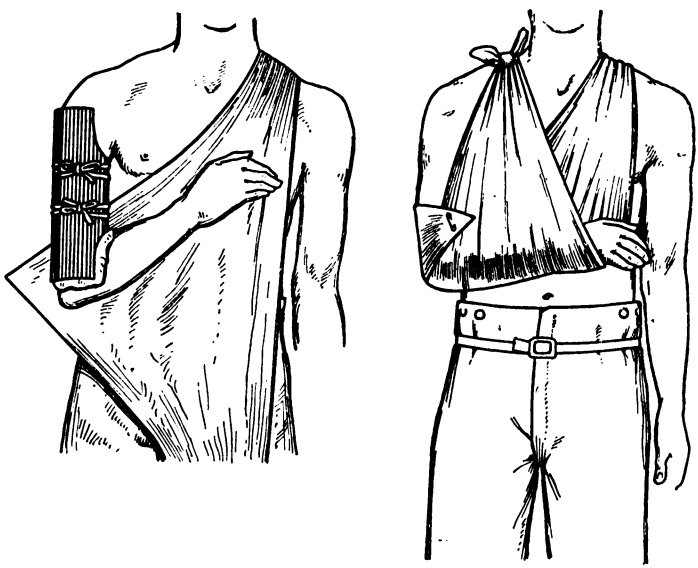

FIG. 62.—Greater Arm Sling.

6. *Neck.*—Apply the centre of a broad-fold over the dressing, pass the ends round and knot on the opposite side, leaving one end long. Take a narrow-fold, tie this to the long end, bring it under the shoulder, and pin to the broad-fold over the dressing. This will prevent the bandage slipping upwards.

7. *Abdomen.*—Place the centre of a broad-fold over the dressing and knot on the side.

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8. *To Apply the Greater Arm Sling.*—Take a whole-cloth, place one end over the sound shoulder, high enough up to allow it to be knotted in front of the shoulder of the injured side, the other end falls down in front of the patient. The point is carried behind the elbow of the injured arm. The injured forearm is carefully raised and placed across the middle of the bandage, the thumb uppermost. The lower end is lifted and knotted to the upper end, in front of the shoulder on the injured side. The point is drawn forward and pinned in front of the elbow.

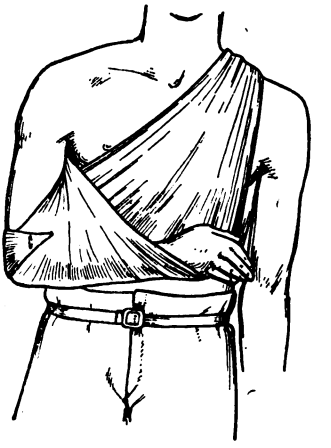

Fig. 63.—Greater Arm Sling.

9. *The Greater Arm Sling for Fractured Clavicle* is applied in a different manner so as to avoid pressure on the fractured ends of the bone. The bandage is arranged as before, but on lifting up the end, it is passed between the upper arm and the chest and knotted to the upper end behind the neck. For application of the other triangular bandages in cases of fractured clavicle, see *Fractures*.

10. *The Greater Arm Sling Reversed.*—This is used when it is wished to take most of the weight of the arm from the elbow and at the same time to keep the hand and forearm in a more elevated position. The upper end is placed over the shoulder of the injured side, the other end hangs down as

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before, the point is towards the sound side. The elbow is bent, and lies in the centre of the lower border, the hand is placed upon the sound shoulder. The lower end is lifted and knotted above the hand, the point is then folded up and pinned to the back of the bandage. The pin should bear no weight.

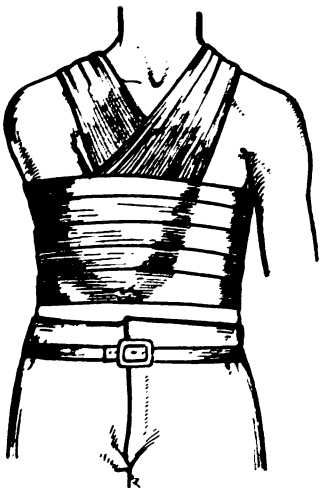

FIG. 64.—Greater Arm Sling reversed and fixed to side.

11. *To Apply the Lesser Arm Sling.* — Take a broad-fold, place one end on the shoulder of the sound side, allowing the other to fall down. Bend the elbow and place the wrist across the middle of the bandage, with the hand a little higher than the elbow. Lift up the lower end and knot to the upper end over the shoulder of the injured side. The greater arm sling reversed supports the arm in a better position than does the lesser arm sling.

12. *To Bandage the Shoulder.*—Lay the centre of the whole cloth on the top of the injured shoulder, point upwards the lower border lying across the middle of the upper arm. Fold in the lower border, carry the ends round the arm, cross and knot on the outer side. Apply the lesser arm sling over the point of the whole-cloth. Draw the point up to make pressure on the dressing, and fold it down and pin off over the shoulder.

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13. *The Elbow.*—Place the centre of a whole-cloth over the back of the bent elbow, point upwards, turn in the lower border, pass the ends round the forearm, cross them in front of the joint and pass them round the arm, including the point of the bandage, and knot behind the arm. Draw firmly on the point to secure pressure, and fold it down and pin off over the elbow. Apply the greater arm sling.

14. *The Hand.*—Take a whole-cloth, place the hand palm down in the centre of the bandage, fingers towards the point, bring the point back over the fingers to the wrist. Pass the ends round the wrist, cross them over the point, which is then folded back towards the fingers and covered by another turn of the ends, which are crossed round the hand and knotted off in front of the wrist.

Or a narrow-fold may be placed with its centre over the dressing, the ends are taken to the opposite side of the hand and crossed, two or three turns are made alternately round the hand and wrist, and the ends knotted. The greater arm sling is then applied, preferably in the reversed manner, to keep the part elevated.

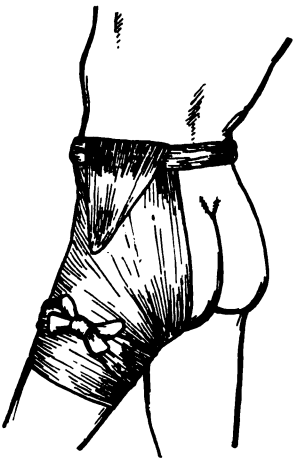

Fig. 65.—Triangular Bandage for Hip.

15. *The Hip.*—Take a narrow-fold and apply it round the waist, knotting in front. Take a whole-cloth, place the centre over the outer side of the

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hip, point upwards, the folded-in lower border should lie across the thigh. Pass the ends round the thigh and knot on the outer side. Draw the point up firmly under the narrow-fold round the waist, and, turning it down, pin off on the outer side.

16. *The Knee.*—Place a broad-fold across the front of the knee, cross behind, and knot in front below the knee-cap.

17. *The Foot.*—Place the sole of the foot in the centre of the bandage, toe towards the point, turn the point up to the front of the ankle. Bring the ends forward to the front of the ankle, cross them over the point, which is folded back towards the toes. Lead the ends round to the back of the ankle, catching in the loose part of the lower border, cross them and bring them forward again and cross on top of the instep over the point. Take one end round the foot under the instep and knot on the inner side.

18. *To Secure Dressings at other Parts of a Limb* the broad-fold is used, its centre is placed over the dressing, the ends are taken round the limb, crossed, brought back and knotted over the dressing.

19. *Perineum and Lower Part of the Abdomen.*—A narrow-fold bandage is tied round the waist with knot in front. Pass one end of another narrow-fold round middle of the first behind, and fasten with a pin, the other end is brought forward between the legs, and attached similarly in front after the manner of a T-bandage.

Another and less effective method is to take a whole-cloth with the lower border uppermost, pass the ends round the waist, and knot off behind,

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leaving one end long. Pass the point between the legs and knot off to the long end behind.

20. *To Fix Splints to a Limb* take a narrow-fold, double it upon itself, so that one end is a little longer than the other. Place the loop thus formed on the splint to the outer side of the limb, pass both ends round the back of the limb, and pass the long end through the loop. The bandage is tightened by drawing steadily upon the two ends, which are then knotted together.

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CHAPTER XVI

Fractures

A FRACTURE is the rupture of continuity in a bone. The causes of fracture are three in number—

1. *Direct Violence* will cause fracture at the point where the bone is struck, for instance, a kick on the shin; in such cases the fracture is usually transverse, there is much local bruising, but unless the force has been excessive there will be very little shortening.
2. *Indirect Violence.*—The force is applied at one place, but the bone gives way at its weakest point or the force may be transmitted to a neighbouring bone and fracture that. The commonest example of this is a fall on the hand, the force travelling up to the clavicle, which snaps, being the weakest bone. Such fractures are usually oblique, and in superficial bones often compound.
3. *Muscular Action* is a less common method, but sudden and excessive contraction is sometimes the cause of fracture of the patella.

Varieties.—There are many varieties of fracture, but all fall into one of two great classes : *Simple* and *Compound.*

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In a *Simple Fracture* there is no communication between the air and the broken ends of the bone. There may be a wound in the neighbourhood, but if this does not lead down to the site of fracture it is still simple.

In a *Compound Fracture* there is a direct communication between the air and the broken ends

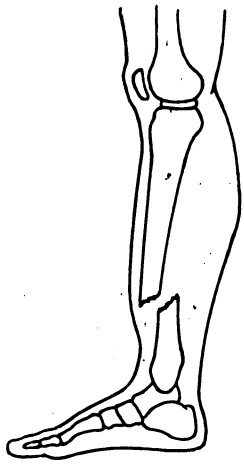

FIG. 66.—Simple Fracture.

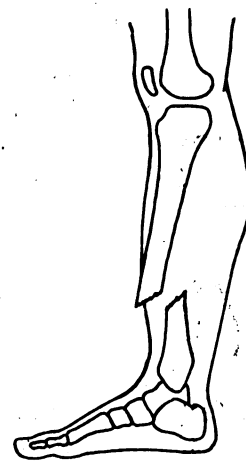

FIG. 67.—Compound Fracture.

of the bones. The distinction is important, as in the compound fracture bacteria may easily infect the bones and the patient lose his limb or perhaps even his life. Many other terms are applied to fractures, some of which need explanation. A comminuted fracture is one where the bone is splintered into more than two fragments; it is often seen where a broad wheel goes over a limb. Comminution is liable to take place at the ends of a bone, the line of fracture often then running into

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the joint, here the terms T- and Y-shaped fracture are often applied.

Green-Stick Fracture is found in the soft but tough bones of the young, which bend double but do not snap. At the outer side of the bend the bone gives way to some extent, but not on the inner side.

Transverse, *Oblique*, *Longitudinal*, all explain themselves. In dealing with flat bones other terms are employed, *Punctured* fracture where a hole has been drilled in the bone, say by a bullet; *Fissured* where the bone is cracked; *Depressed* and *Elevated* where one piece is driven below or above the level of the rest of the bone.

The signs of fracture vary greatly in extent, they are—

1. Local pain and local injury.
2. Abnormal mobility accompanied by pain.
3. Deformity, which may be gross distortion of a limb, angling or shortening when compared with the other side.
4. Crepitus, which is felt by the hand on moving the limb, as a harsh grating sensation made by the rough ends of the bone rubbing together.

Diagnosis is rendered much easier now by the use of the X-rays.

The Union of Fractures.—The fractured bones having been set end to end the tissue is mended in much the same way as healing in other tissues, except that it takes longer as it has to become hard bone. Just after a fracture, the two ends of the bone are more or less separated and the periosteum is torn up. The force of the injury, and

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perhaps careless or rough handling later, has caused laceration of the muscles and tissues round about, and a great deal of blood has been extravasated in the region.

During the first week inflammatory changes have full play, there is a greatly increased vascularity and an abundant exudation. By this means the effused blood and damaged tissue is gradually removed. A round-celled infiltration takes place and soon afterwards there is the formation of loops of blood-vessels forming granulation tissue. So far these changes are the same as in ordinary wounds, but accompanying the round cells which have infiltrated all about are cells called *Osteoblasts* or bone-formers which have come from the broken ends of the bone and from the torn periosteum. These bone-forming cells begin to lay down bone, so that the soft granulation soon becomes tough and elastic and is called *Callus*. This callus fills in the space between the bones and forms a large spindle-shaped mass holding the ends together. As the callus gets harder, less is needed to hold the ends of the bones in position and absorption takes place. Increasing hardness and absorption go together so that by the sixth to eighth week the two fragments of bone have become re-united by bony tissue and only very slight thickening marks the site of the injury.

The time required for firm union varies considerably, it is longer in larger than in small bones.

Setting a Fracture.—If a fractured bone is to recover its full use it is necessary that the broken ends of the bones should be placed as far as possible in their natural relations to one another, and after

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that to wait and allow nature to complete the cure. If they are allowed to remain overlapping, the callus will fix and then join them in this position and considerable deformity and shortening will take place. This is termed *Vicious* union. After the bones have been replaced or set, splints are required to hold them in the correct position and prevent subsequent displacement till the callus has formed. If they are not fixed by some apparatus every movement of the limb causes disturbance between the ends of the bone and new bone may not be formed, a condition of non-union being the result.

First Aid in Fractures.—In every case of fracture great care must be taken to prevent any undue movement taking place, as the sharp end of the bone may easily rupture the skin and convert a simple into a compound fracture. If there is any real doubt as to whether the limb is fractured, it should be treated on the supposition that such an injury has been sustained. If possible a person with a fracture of the lower extremity should remain lying until skilled assistance can be obtained; on no account should friends help him to his feet and assist him to walk.

Splints should be extemporised of material stiff enough to prevent undue movement, the materials usually to hand are pieces of wood from boxes and packing cases, sticks cut from the hedge, walking sticks, umbrellas, cardboard, stiff paper folded, straw tied in bunches, bayonet and rifle. Whatever material is used should be fastened securely to the limb with handkerchiefs, strips of linen, string, scarf, neck-tie, puttees or belt. The two limbs should then be tied together at the ankles and above the knees

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for greater security. In handling the limb great gentleness must be observed, and when the patient is to be lifted on to the cart, gate or stretcher, for removal, one man should be told off specially to attend to the broken limb.

If the upper limb is injured, it can be supported in a comfortable position by a sling and the patient can walk or be removed home.

In compound fractures a first-aid antiseptic dressing must be applied to the wound while the splints are being prepared. At the earliest opportunity the surgeon cleanses the wound thoroughly, if necessary he may enlarge the wound the better to do this. He then may sew up the wound, but more frequently he puts on an antiseptic dressing and arranges for free drainage from the wound.

Management of Fractures.—If the patient has to lie in bed, especially in fractures of the lower extremity, the ordinary narrow hospital bed should be used. If this is not to hand, the bed should be prevented from sagging in the middle by boards about a foot wide being pushed across from side to side beneath a firm horse-hair mattress. Soft mattresses and feather beds should never be used.

When undressing the patient the boots should be fully unlaced, and while one hand steadies the limb the boot is drawn off with the other. Top boots should be slit up the seam at the back. Garters and suspenders must be undone before the stockings or socks are drawn off. When taking off the trousers the braces should be unbuttoned in front and behind and the sound leg withdrawn first, if there is any difficulty it is best to slit up the seam on the outer side of the trousers, they can then be repaired

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subsequently. In taking off the coat the sound limb is withdrawn before the injured. When the patient is placed in bed the injured limb can be supported by sand-bags, or bricks wrapped in towels, placed alongside, these will prevent movement until such time as the fracture can be set. The bedclothes are kept from pressing on the limb by a cradle, or

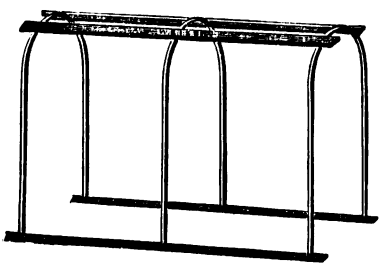

FIG. 68.

if this is not handy by a chair or stool arranged to perform the same office.

Fractures of Special Bones.—*Fracture of the Lower Jaw.* This is usually caused by a blow on the side of the face and sometimes by a fall. There is great difficulty in opening the mouth and speaking. Nearly always there is bleeding into the mouth from a tear of the gums or looseness of the teeth. The fracture, therefore, is nearly always compound.

Management.—The jaw is kept at rest, attempts at talking and chewing are forbidden, and as soon as possible a four-tailed bandage applied to fix the teeth of the lower jaw into their natural position against the teeth of the upper jaw, which is thus made to act the part of a splint. The mouth is kept as clean as possible by continually washing it out with an antiseptic mouthwash (1 in 80 carbolic). All

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food should be given in liquid form for the first ten days.

A four-tailed bandage is made by taking one and a half yards of three or four-inch calico bandage, doubling it up, cutting a slit in the centre and then tearing each side down to within two inches of this slit. The slit is then laid over the point of the jaw

FIG. 69.—Bandage for Fractured Jaw.

and the two lower ends are tied up over the front part of the head, the two upper ones are drawn backwards and tied behind. The ends behind and those on top can then be tied together to prevent slipping; an even better method is shown in Fig. 69.

Upper Extremity.—1. *Fracture of the Clavicle* is an exceedingly common injury caused by falls on the shoulder or hand. A patient with this bone broken bends his head to the injured side and supports the disabled limb with the other hand.

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Some irregularity can be felt by passing the fingers gently along the bone.

Treatment.—The fracture is first set and then may be retained in position by various means. In each method a pad of wool or other substance is placed

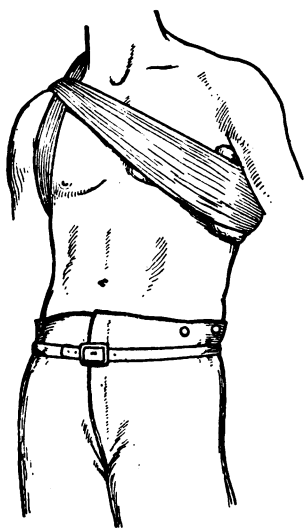

FIG. 70.—Bandage for Fractured Clavicle.

in the axilla, and the skin surfaces of the arm and chest are kept apart by the same means.

(*a*) *Sayre's Method.*—By two strips of adhesive plaster, two and a half to three inches broad. This method is used in hospitals and places where the material can be obtained. A loop of plaster is fixed, adhesive side out, by stitches or a stout safety pin, around the middle of the upper arm, drawing the arm well back; the strip is carried across the back and round the chest till it ends behind by

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becoming adherent to the first part of the turn. This gives a fixed point on which the second strip acts. The elbow is bent and the hand laid on the sound shoulder and fixed in this position by the second strip, which is carried from the sound shoulder obliquely down the back to the elbow, where a slit is made to receive the point of the elbow and

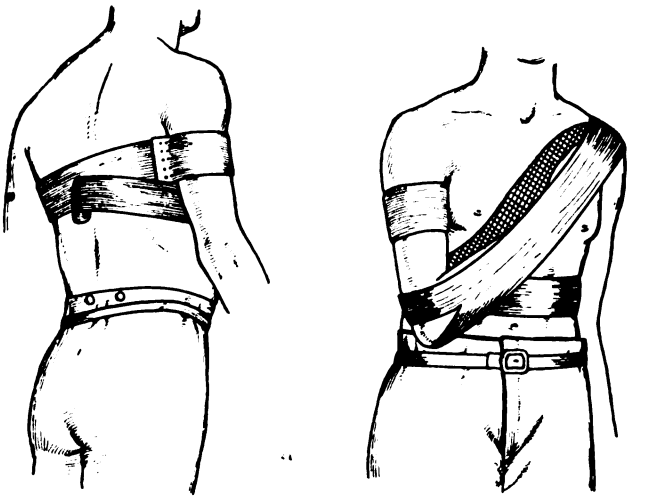

FIG. 71.—Sayre's Method of Bandaging for Fractured Clavicle.

then up the back of the forearm to the starting-point. A broad bandage or a third strip of plaster then binds the arm to the chest. This method allows the fracture to be inspected without disturbing the dressing and there is no pressure made on the broken bone.

(*b*) *Pad and Triangular Handkerchiefs.*—Wool or padding and three triangular handkerchiefs are required. A handkerchief is made into a narrow-fold, in which the padding is arranged so that one

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end is longer than the other. The pad is placed in the axilla and the ends crossed over the opposite shoulder, the long end then passes under the axilla and is tied in front. If tied behind the knot is uncomfortable to lie on. The elbow is bent and the hand placed on the sound shoulder. The second sling is used as the greater arm sling. The third handkerchief is made into a narrow-fold and is tied round the arm and chest. If short of handkerchiefs a belt can be used in the place of the last. This method prevents the fractured bone being seen without undoing the greater arm sling; a certain amount of pressure also falls upon the site of the fracture. Both of these faults can be avoided, however, if, instead of placing the upper end of the sling over the shoulder it is put between the arm and the chest and passed across the back to be tied over the opposite clavicle.

(*c*) *Interlaced Handkerchiefs.* — Two triangular handkerchiefs and padding are needed. The handkerchiefs are made into narrow-folds with some padding placed in the centre. One is then laid across the front of each shoulder so that the padding is in the axilla. The ends are interlaced behind and brought round and tied in front of the opposite shoulder. By this means the shoulders are braced back and the fragments kept in position. This method is better than knotting the handkerchiefs behind where they are lain upon, but it is not so comfortable as the method previously described.

2. *Fracture of the Humerus.* (*a*) When *the shaft of the bone* is broken shortening is usually present and crepitus easily obtained. The radial nerve which winds round the back of the bone may be

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damaged at the time of the injury or involved by the callus later, causing paralysis of the extensors of the wrist and wrist-drop.

Treatment.—After the fracture is set Gooch-splinting material is often used to retain the parts in position. It is cut in the shape shown in Fig. 72, so as to avoid pressure on the bony points. A sling is used to support the hand and the whole fastened to the chest under the clothing so as to prevent movements at the shoulder and elbow. A rectangular splint is sometimes used to control the elbow joint; it

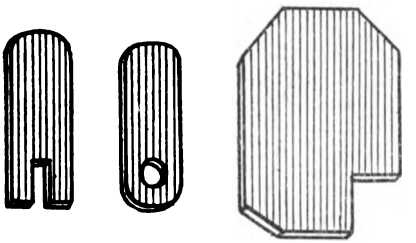

Fig. 72.—Splints of Gooch Material for Fractured Humerus.

should be applied to the outer side of the arm with a short splint to the inner side of the upper arm. A sling is used to support the forearm and prevent movements of the shoulder. Delayed or non-union of fractures in this situation is due to the patient being allowed to use his arm too soon.

(*b*) *Fracture of the Upper End of the Humerus* occurs from falls on the shoulder.

Treatment.—A shoulder cap should be fitted to control the shoulder and may be fashioned as a rectangular splint to control the elbows as well. A paper pattern should first be cut and fitted to the

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sound side, the pattern is then laid on poroplastic or cardboard and the shoulder cap marked and cut out. Early passive movement and massage are of great value in preventing adhesions forming in the joint.

(*c*) *Fractures of the Lower End of the Humerus* are very common in children and young people up till twenty years of age, in whom the epiphysis may be separated from the shaft. Many of the fractures in this neighbourhood are T- and Y-shaped and involve the joint.

Treatment.—After careful setting these fractures should all be treated with the elbow bent as much as

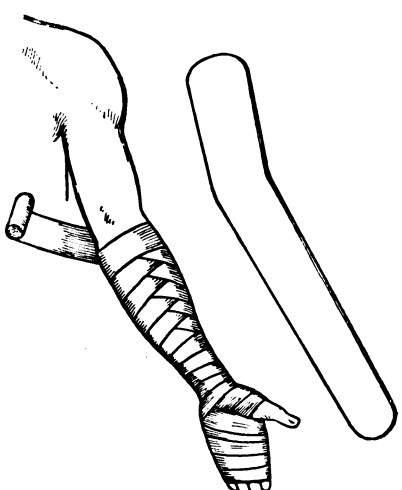

FIG. 73.—Bandage and Splint for Arm.

possible. In many cases no splint is needed as the arm can be fixed in the bent position by a strip of plaster put on as in Sayre's method for fracture of the clavicle. The skin on the front of the elbow

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should be well powdered with boracic acid to prevent the swollen opposing surfaces irritating each other, and in children the points of pressure must be protected from the strapping with a layer of lint. A rectangular splint can also be used, but is not to be recommended. Massage should be commenced after the first week and slight passive movements after the second.

3. *Fractures of the Bones of the Forearm* about their middle are best treated with the elbow flexed

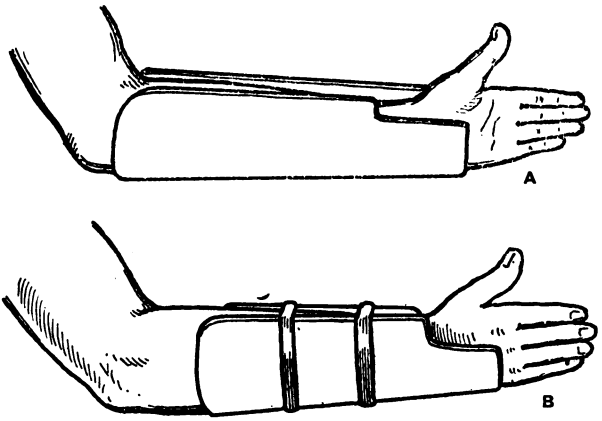

FIG. 74.—Splint for Forearm.

to a right angle and the hand in the position it assumes when laid flat on the opposite side of the chest, that is with the thumb uppermost. A rectangular splint is applied to the outer side, while a short splint is placed on the inner side. This latter splint extends from in front of the elbow to the middle of the palm and is cut away at the end to avoid pressure on the ball of the thumb. The arm is supported in a greater arm sling.

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4. *Fracture of the Olecranon* is caused by falls on the point of the elbow which break off this process of bone. The triceps muscle is inserted into the olecranon and draws the fragment away from the rest of the ulna, so that it is very difficult to get the two portions approximated satisfactorily.

Treatment.—The modern treatment is for the surgeon to open up the site of fracture and fasten the two pieces firmly together by means of silver wire or screws. Where this cannot be done safely, a horseshoe-shaped piece of plaster with tapes attached is fixed to the back of the arm, the olecranon lying in the hollow of the horseshoe. A splint of tin or Gooch material is fixed to the front of the forearm and upper arm. The splint should be long enough to project beyond the fingers. Elastic bands can now be attached to the tapes and fastened to the end of the splint; they will help to draw down the olecranon and keep it close against the upper end of the ulna.

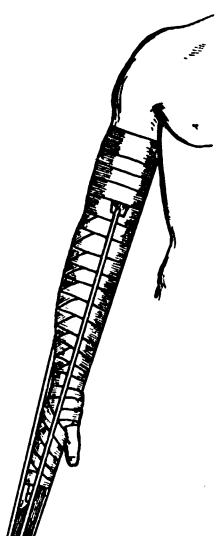

FIG. 75.—Extension for Fracture of the Olecranon.

5. **Colles's Fracture of the Lower End of the Radius** is the commonest of all fractures, especially is it met with in elderly women. The injury is the result of falls on the outstretched hand. The styloid process of the radius is normally about half-an-inch below that of the ulna, but when fracture has been sustained, this process may be on a level with, or even

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at a higher level, than that of the ulna. The wrist also assumes a peculiar fork-like appearance. This serves to distinguish the injury from a simple sprain of the wrist. The fragments are usually impacted and no crepitus is felt, the injury is often thought to be a sprain.

An anæsthetic is usually needed and powerful extension and flexion must be applied to replace the fragment. Special splints present no advantage and two pieces of Gooch are as good. The back splint reaches to the knuckles, the front to the middle of the palm. The fingers should be moved freely from the third day. The back splint is left off and the wrist moved at the end of a week. Both splints are left off at the end of a fortnight. The arm should be worn in a sling for three weeks, and not used in hard work for a month. The early movement prevents the wrist becoming stiff.

6. **Fractures of the Metacarpals** can usually be felt on the back of the hand as irregularities in the course of the bone. They are best treated by placing a large pad in the grasp of the hand; a ball of worsted, over which the fingers and thumb are widely separated, is very good for the purpose. The hand is then bandaged in this position for ten days. Another method is to apply a straight splint to the front of the forearm and hand, projecting beyond the fingers, elastic extension can then be applied to any of the digits.

7. **Fractures of the Phalanges** are treated by wrapping the injured digit in wool and binding it to its fellows in the extended position and applying a splint at first to all the fingers, and later only to the injured one.

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Fracture of the Lower Extremity. — Fractures of the lower extremity have many features in common, the most important of which are: obliquity of the fracture—usually it runs from above downwards and forwards, shortening, and the tendency for the weight of the foot to roll the lower fragment outwards. In fractures of the leg there may be some drawing up of the heel. Extension is very often applied to the lower limb in cases of fractures to overcome the shortening by relaxing the contracted muscles, and to hold the limb still when the eversion has been corrected. All eversion is corrected when the inner edge of the patella and internal malleolus and the ball of the great toe are all in the same vertical plane.

Extension Apparatus.—This requires strong plaster strapping, broad tape, scissors, needle and thread, cotton bandages, a square piece of wood broader

FIG. 76.—Extension Plasters.

than the distance between the two malleolli having a hole in the centre and buckles and tapes from two opposite sides. Bricks or wooden blocks three or four inches high on which to raise the foot of the bed. A bag or tin filled with shot or sand to act as the weight.

The strips of plaster should be long enough to reach from the level of the sole up to and some distance beyond the point of fracture. They may both be cut from one rectangular piece or each may be fashioned separately, they should be broader

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above than below. A piece of tape is placed about two to three inches from the lower end, slits are cut in from each margin and the sides folded in over the tape so that this adheres firmly to it. With the needle a few stitches are passed through all the layers and the tape is thus firmly fixed. At an interval of another two inches above the level of the tape another shallow snip is made in each margin and the sides turned in so that the adhesive surface is covered and will not later stick to the

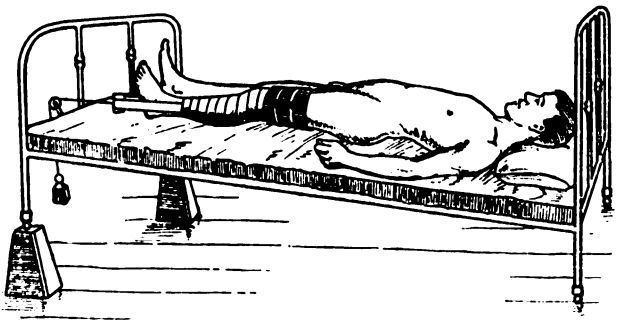

FIG. 77.—Extension for Thigh.

malleoli. Oblique snips are made on the margin of the plaster all the way up so that it will take the shape of the limb.

When everything is ready the limb should be soaped and shaved. A figure-of-8 bandage is then applied round the ankle to protect the malleoli. The strips of plaster are then heated before the fire, or by placing them, sticky side outwards, against a can of hot water; where heat is not available a pledget of cotton-wool dipped in chloroform, ether, or turpentine and sponged rapidly over the plaster will act in the same way. The plaster is applied to

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each side of the leg, the upper end should extend above the level of the fracture, but should not be stuck down. A bandage is now applied over all from above the ankle; as the site of fracture is approached, the upper end of the plaster is turned down and incorporated in the bandage which then cannot slip.

Instead of a bandage narrow strips of plaster about an inch wide can be applied obliquely up the limb over the plaster to fix everything in position. In children, where the skin is delicate, it is better to bandage the limb first and apply the plaster to the bandage, a second bandage or strips of strapping being used to fix all securely. When the plaster is secured the tapes are buckled to the square piece of wood, through the centre of which a strong piece of cord is threaded with a knot at the end to prevent its slipping. The other end of the cord passes over a pulley. The limb is then left supported by sand-bags for some hours to allow the plaster to grip firmly, at the end of which time the weight can be attached to the cord. The weight needed depends on the strength of the muscles; three to four pounds are sufficient for a child of five to six years old, six to eight pounds for an adult.

The limb is arranged in a comfortable position and the pulley adjusted so that the pull is in the direction of the limb. The bed is then raised on blocks so that the weight of the body acts as the counter extending force.

The plaster is carried high up the limb to the site of fracture, so that a good grip is obtained directly on the lower fragment and the weight is not made to act through the ligaments of the

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knee joint, which might be stretched under the strain.

If there is pain in the joints below the fracture the weight should be decreased. If there is spasm it should be increased. Careful measurements should be taken daily, and when they are equal on the two sides the weight can be decreased.

1. **Fracture of the Femur.**—(*a*) *Fracture of the Neck of the Femur.* This is liable to occur from any slight trip in old people, especially in women, and is sometimes very difficult to diagnose. It is sometimes impacted and in such cases the impaction should be left undisturbed. The treatment of old people is a difficult matter as they cannot stand the strain of close confinement. The condition of the lungs, heart, bowels and kidneys must be constantly examined. The difficulties of expectoration in bronchitis, micturition and defæcation when lying on the back take some time to overcome. Flatulence often occurs and by distending the abdomen embarrasses the action of the diaphragm, the lungs and the heart suffer and hypostatic pneumonia is common. For these reasons all attempts at treating the fracture must sometimes be abandoned and the patient allowed up. In younger people, however, the following methods may be used—

(i) *Long Splint and Extension.*

The materials needed are those for the extension apparatus. A long splint four inches wide and of sufficient length to reach from the axilla to six inches beyond the foot, a foot piece for the splint, a sheet, bolster slip and safety pins to fix it, cotton wadding or pads already made up.

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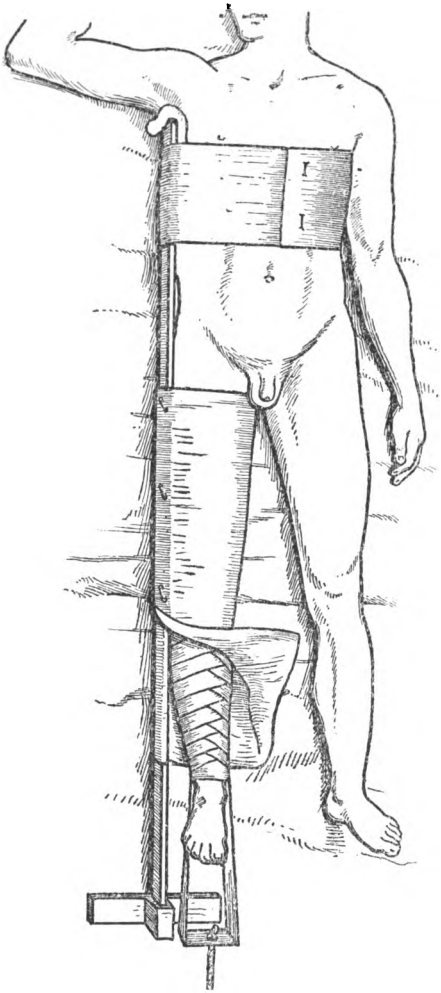

FIG. 78.—Long Splint and Extension.

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The extension is applied in the way already detailed. The sheet is folded so that it corresponds to the length of the limb and the bolster slip is laid close by. The long splint is taken, the upper end of the splint is placed between the folds of a towel which projects beyond it. The splint is then rolled up in the sheet and the bolster slip until there is only sufficient left of the former to cover in the limb and of the latter to surround the chest, the bolster slip also fixes the towel to the splint. The dressed splint is laid along the side of the patient, the towel is folded down as a pad for the axilla, the bolster slip encircles the chest and the sheet envelops the limb, pads being placed at the hip, knee and above the ankle. The sheet and the slip are fastened off on the outside of the splint with pins. The foot-piece is then applied to keep the splint at right angles to the bed.

(ii) *Long Splint and Perineal Band.*

This was the original method of using the long splint, and has still to be used when for some reason extension plasters cannot be applied. The splint is wrapped in the sheet and bolster slip as before, but the towel cannot be laid round the upper end till later. Two triangular handkerchiefs are made into narrow-folds, one is fastened to the foot and ankle and the ends knotted together, the other is passed between the thighs round the perineum. The prongs of the lower end of the splint are slipped through the loop of the lower handkerchief, while through the holes of the top end of the splint are

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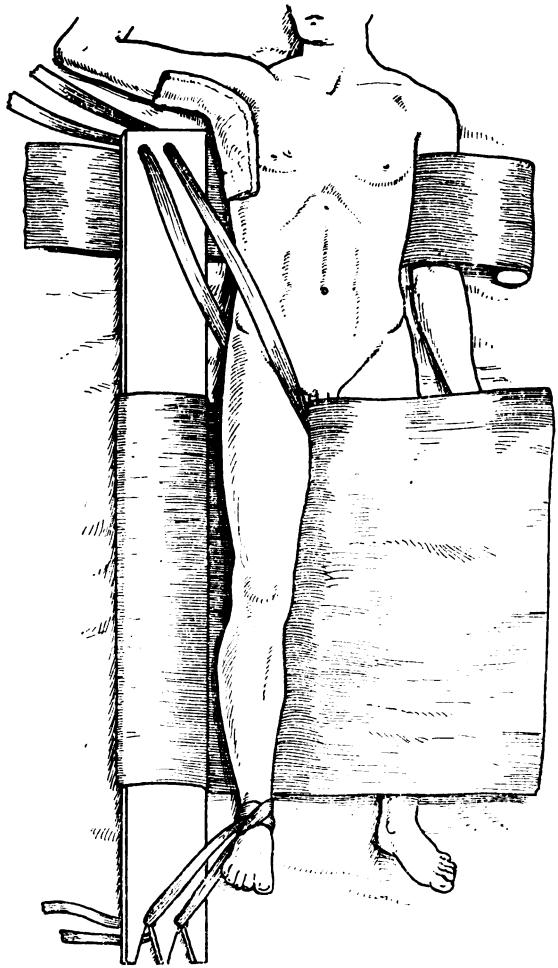

FIG. 79.—Long Liston's Splint and Perineal Band.

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passed the ends of the perineal band; when the splint is pressed firmly down extension is made on the foot. The perineal band is then tied off tightly and makes the counter extension. The towel is placed round the upper end of the splint and the sheet and slip fastened off as before. The handkerchiefs stretch and need constant attention, the perineum is apt to become uncomfortable or excoriated, and the method is much inferior to extension by weight and pulley.

(*b*) *Fracture of the Shaft of the Femur.*—These are often treated with extension and the long splint, but in addition to this local Gooch splints, three in number, one anterior and two lateral, are usually applied and secured in place with slip-knots. The splints must not encroach upon the patella or groin, the upper end of the anterior one must be slanted off. If the fracture is high up near the hip or low down near the knee the smaller fragment may be difficult to control, and in that case the long straight splint is not so suitable as some form of inclined plane which keeps the limb in a bent position.

(i) Hodgen's Splint. Materials.—Hodgen's splint of appropriate size to extend from the groin to beyond the sole of the foot. Extension strapping, tapes and stirrups, strips of house flannel, needle and thread, suitable gallows to which the splint can be slung. The extension plasters are applied as usual, strips of flannel about seven inches wide are laid under the limb, slightly overlapping each other. The iron frame

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of the splint is laid on the limb and the strips of flannel are turned up over the sides of the frame, one after another, and stitched in position. The limb now lies in a trough of flannel, the sides formed by the splint. The stirrup with the extension tapes are tied firmly to the part of the frame beyond the foot. Cords are then attached to the rings in the frame and the limb swung clear by a pulley on an upright.

(ii) MacIntyre's splint is rather easier to use and is just as effective for fractures low down in the femur. The splint is duly padded and laid aside, with the screws so adjusted that the splint will fit the bent knee. An extension is applied in the usual way. The splint is applied to the back of the leg and thigh and fastened in place with strapping. The extension tapes are tied together below the foot-piece and the whole splint swung in a cradle.

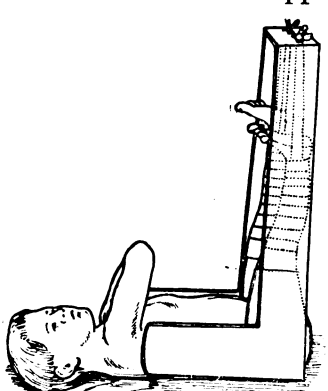

Fig. 80.—Gallows Splint.

(c) *In Children Fractures of the Shaft of the Femur* are quite common. Children are sometimes difficult to control and to keep clean and dry, it is therefore usual to put them up either in a double long splint which will prevent

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all movements or in a gallows splint with the limbs in the vertical position. In the latter position the child is easily attended to, extension is made by a pulley on the injured limb, the weight of the body acting as the counter extension force.

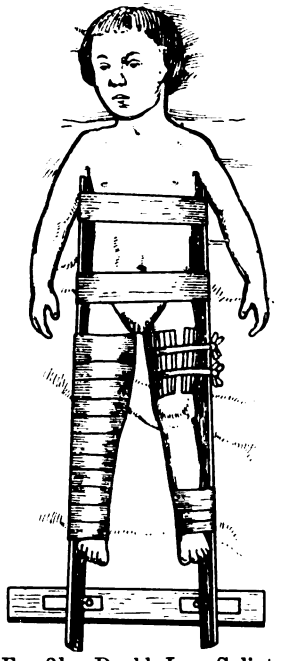

FIG. 81.—Double Long Splint.

2. Fractures of the Patella are very similar to those of the olecranon. In the common transverse variety there is marked separation of the pieces of bone, and the limb swells to an enormous size from the collection of blood and synovial fluid in the joint. The limb should be put on a straight back splint and wool and a firm bandage applied to curb the swelling, or evaporating lotions or even an ice-bag applied. After a few days' active measures may be pursued.

(i) *Extension Method.*—This is the same as described for the olecranon, only a larger horseshoe-shaped plaster is required. A small horseshoe of plaster may be applied to the lower fragment to steady it. The limb is placed on a back splint with the foot raised to relax the muscles on the front of the thigh. Elastic tension is

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fitted to the two plasters and attached to the splint. Later a plaster of Paris bandage is applied. Ligamentous union is the result and the joint is usually weak.

(ii) *Operative Methods* are in very common use in hospitals and places where skill and conveniences for such are available. Strict asepsis is necessary, for the danger, of sepsis in the knee joint can scarcely be exaggerated. The surgeon opens the joint, clears out the clot, and wires the fragments together. Movements can be allowed in three weeks' time.

3. **Fractures of the Bones of the Leg.**—If both bones are broken there is usually marked distortion of the limb; this may be quite absent when only one has given way, as the other bone remains as a natural splint.

After careful setting the limb may be treated with extension and weights; when the fracture is low down a fan-shaped extension will take a better grip of the lower part and avoid undue strain on the ankle joint. Different forms of splints can be used with or without extension.

(i) *The Box Splint.*—For all fractures of the lower limb below the middle of the thigh there is no apparatus which is more universally used than this.

Materials.—Two pieces of light wood, three are better, four inches broad and long enough to extend from above the knee to below the sole. Towels,

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bandage and padding. All these can usually be found in any cottage.

A large towel is spread out beneath the sound limb and the other two pieces of wood are rolled in opposite ends adjusting them till they just leave room for the limb. The damaged limb is raised and the fracture

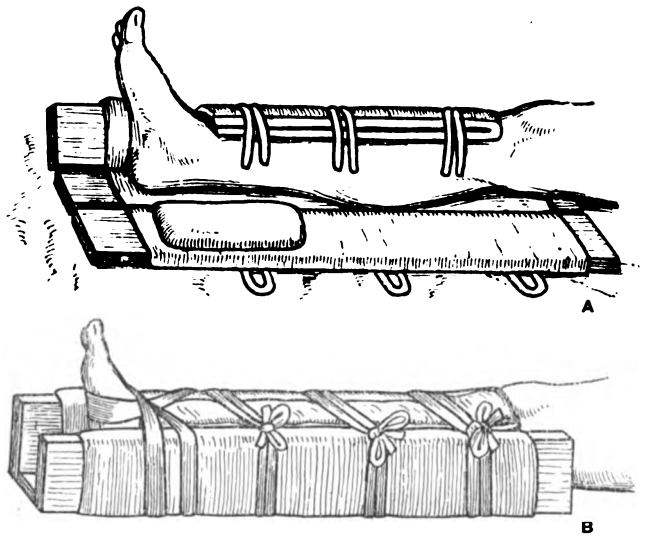

Fig. 82.—Box Splint.

set, the splints are slipped underneath and the leg lowered, the sides of the box are elevated and held in position by the hand. One side is then allowed to fall and pads placed in the popliteal space and above the heel, at the sides of the knee and above the malleoli. The two smaller towels are folded so as to cover in more

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than half the length of the leg; they are laid one overlapping the other on the shin and the splints secured by three slip-knots. The foot is bandaged by figure-of-8 turns to the sides to keep it steady and ensure the inner border of the patella, malleolus and ball of great toe are in line. One can see at a glance if there is any rotation. If the site of fracture is to be inspected, all that is necessary is to undo the middle slip-knot, fold back the overlapping ends of the towels and it is exposed without disturbance. While in the box splint the whole leg may be kept straight or slung in a cradle with the knee slightly bent. There is a decided tendency for the heel to pass backwards, this is obviated by passing a third piece of wood upwards between the layers of the towel in which the sides are folded. If wished, the extension can be used. In places where such can be obtained a Neville's splint can be incorporated in the slip-knots, the foot-piece will help to steady the foot.

Other Splints. — *The MacIntyre Splint* is an extremely good splint for all injuries of the leg. Its use has already been mentioned in connection with the femur. It has the merit of being adjustable to the length of different limbs, and will take the knee straight or bent. There is also a button on the bottom of the foot-piece which will support a sling to prevent the heel passing backwards.

Lateral Splints are sometimes used. A hole is

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usually made for the malleolus and the outer splint should have a foot-piece. The splints are fastened with buckles or slip-knots. With these lateral splints the limb may either be slung in a cradle or laid upon its outer side with the knee flexed to relax the calf muscles—a position of great comfort.

Dupuytren's Splint is a long Liston's splint in miniature and is applied to the inner side of the leg in cases of Pott's fracture to counteract the

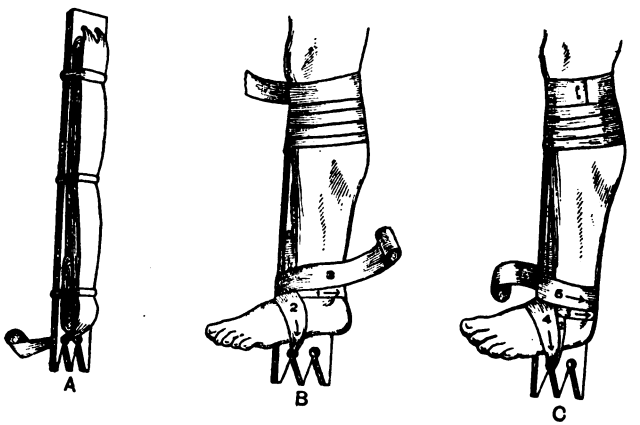

FIG. 83.—Dupuytren's Splint for Pott's Fracture.

eversion. A towel is applied to the inner side and serves as padding, its lower end is folded up to form a pad above the prongs. The tail of a bandage is split and the ends threaded through the two holes at the top and tied, the bandage is lead down over the towel and serves to keep it in place and is then hitched round a prong. A broad piece of strapping or a bandage secures the splint to the leg below the knee. The ankle is now fixed to the lower

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end of the splint by four or five figure-of-8 turns which pass firmly down over the outer side of the foot, through the prongs and then lightly round the ankle near the fracture, the foot being inverted over the towel pad. Finally, the leg is laid on its outer side on a pillow.

Fracture of the Ribs is commonly the result of blows, crushes or falls. The upper four ribs are protected by the shoulders and collar bone, the lower two or three are so mobile that they escape injury. Those in the middle of the series are the ones fractured. Pain is felt locally and is increased on breathing or coughing, crepitus is felt with the flat of the hand.

Treatment.—If strapping is at hand strips should be cut long enough to pass round the injured side and extend over the mid-line both in front and behind. The patient is told to let out as much breath as he can and to breathe very shallowly and rapidly, so that little movement takes place. The strips are then applied from below upwards, each strip overlapping its predecessor. If this cannot be done the chest should be steadied by a broad bandage.

Complications.—The attendant should be in readiness to report grave symptoms which may arise in severe injuries from the sharp ends of the ribs penetrating the viscera below. The lung may be injured, in which case spitting of blood will be noticed. The pulse may get rapid and the face pallid from severe internal hæmorrhage from the liver, spleen or lungs. At a later stage pneumonia may be set up.

Fracture of the Pelvis is the result of a crush

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or a fall, and is always serious from the risk of injury to the internal organs, either the bladder, urethra or bowel.

The treatment consists in laying the patient on his back, fixing the pelvis by a broad binder or by strapping, the knees should be flexed over a pillow. If he has to be moved about, the legs must be tied together. Inquiries must be made as to whether the patient passes water or not and a note made of the fact. If water is passed it should be examined to see if it contains blood. If the urethra has been injured blood may escape apart from passing water. If any swelling appears in the perineum after attempts to pass water it should be reported at once as an extravasation of urine may be taking place into the tissues. These cases usually require rest in bed for a period of from six to twelve weeks, during the earlier stages of which any movements must be carried out with great care.

Fracture of the Spine. — In this injury the symptoms vary with the amount of injury inflicted upon the spinal medulla, and with the level of the spinal medulla affected. High up in the neck fracture of the vertebræ is often fatal at once, while at a lower level there is paraplegia, which may be temporary or permanent according to the severity of the case. In these cases there is absolute paralysis of the muscles which receive their nerve supply from the medulla below the injury, there is also complete loss of sensation below this level. There is also a curious but not obvious result in the tissues themselves, for cut off as they are from nerve influence, their nutrition suffers severely and they are very liable to ulcerate; this not only applies to the skin, which

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breaks down easily to form bed-sores, but is the same for the mucous membrane of the body, and for this reason the bladder is very liable to go wrong.

Management.—As one cannot tell at first the exact amount of damage that the spinal medulla has sustained, it is most important that no further damage should be inflicted by carelessness in moving and attending to the patient. When any movements have to be carried out, such as lifting or rolling the patient on to his side, great care must be taken to see that the patient is lifted or rolled evenly, and that no movement takes place at the site of injury.

The strictest attention must be paid to the skin to prevent bed-sores forming over the points of pressure, and the greatest care taken that no germs are introduced into the bladder by the use of the catheter. Beyond this the same treatment is needed as is given in cases of paraplegia.

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CHAPTER XVII

INJURIES TO JOINTS AND HEAD INJURIES

Injuries to Joints

Sprains and strains of a joint are due to over-stretching or partial rupture of the muscular and ligamentous tissues of the joint. This may occur in many ways, such as a fall on the hand pressing the hand back, or jumping from a height, bending the foot too far upwards, or it may be the result of a wrench or twist as a fall with the knee bent and the leg underneath.

At the time there is great pain which causes a feeling of faintness or a sick feeling, after which the person feels cold and perspires freely. The joint soon swells and becomes very painful, as the cavity fills with the synovial fluid and inflammatory exudation which is rapidly poured out; often this fluid is blood-stained from the rupture of small vessels.

Swelling takes place also in the tissues round about the joint, and in a few days the discoloration of the extravasated blood shows itself.

Management.—The limb should be put at rest as soon as possible, and the sooner it is examined by a surgeon the better. If examination is delayed the swelling of the tissues round masks, and renders it difficult to make out, the exact nature of the injury. A splint is often applied to control the joint. To

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the joint a hot or a cold fomentation is applied, or the limb soaked in water as hot as can be borne, after this a layer of wool is applied and the part bandaged firmly to control the swelling. If a splint is applied, three or four days is the longest it should be kept on. Massage and gentle passive movements will do more good than absolute rest. Especially is this the case with the knee joint. If this joint is injured walking should be prohibited, the joint bathed and bandaged, and the massage applied chiefly to the thigh muscles which control the joint. Unless these muscles are kept in good order they will waste very rapidly, then when walking is resumed they are unable to take care of the movements of the joint, and the swelling immediately reappears. When the pain and swelling has gone movements should be carried out. When walking is allowed the knee should be well strapped, this gives a feeling of confidence and also replaces to some extent the relaxed ligaments. After a time when the muscles are strong and the joint feels well the strapping can be left off.

Dislocations are severe injuries to joints and are analogous to fractures of bones, they are brought about by the same causes. In a dislocation one bone tears through the ligaments and leaves the joint cavity.

The signs of dislocation are—

1. Pain in and around the joint.
2. Abnormal fixity, as all the muscles are contracted so as to prevent movement.
3. Deformity of the limb in the region of the joint.

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The chief help in diagnosis is finding the ends of the bones displaced and in an abnormal relation to one another.

The commonest joint to sustain dislocation is the shoulder, but the elbow and the jaw are quite common, while almost any joint may be dislocated. It is said to be a compound dislocation if there is a wound leading down to the joint cavity.

Management.—The surgeon should reduce the dislocation without loss of time. Considerable skill and knowledge is necessary to recognise and reduce injury of this nature, and lay people should not attempt reduction as they are more likely to tear the tissues still further than to benefit the patient. Great swelling comes on rapidly and later the discoloration from bleeding into the tissues is seen. After reduction, the joint should be kept at rest to allow the rent in the capsule of the joint to heal. Massage can be started in two days' time and passive movements at the end of a week. This will help the absorption of the inflammatory exudate which fills the joint, which if left will cause adhesions and loss of movement in the joint.

Full movements calculated to stretch and open the rent in the capsule should not be allowed for a month or six weeks, or the capsule may become so loose that dislocation may take place on performing ordinary movements.

Head Injuries

Injuries to the head are important from the risk of injury to the brain either by the accident itself or from sepsis later.

After every head injury there are certain clinical

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conditions which it is important to understand. They are in order of severity *concussion*, *cerebral irritation* and *compression*. After an injury a patient may be found in any of the three, depending on the severity of the injury received, or he may pass gradually from concussion to irritation, and on to compression as the symptoms become more and more severe.

Concussion is the state in which a patient lies stunned as the result of an injury to the head. He lies limp and unconscious, but can usually be roused for a moment by shaking or shouting at him. The pulse is weak, respirations shallow, pupils equal, and the skin cold and bathed in perspiration. Concussion is very like shock. Concussion may last from a few moments to days, but after a variable time the patient turns over on his side, and usually vomits and the stage of reaction sets in. He then lies curled up with the hips and knees bent, draws the clothes over his head and avoids the light. He becomes extremely irritable and resents any attention. The temperature rises and the pulse becomes strong and rapid, the face is flushed and he has great headache.

This stage lasts some days. It is followed by the stage of convalescence, during which time he is still irritable, his memory defective, and he is fatuous and childish, unable to concentrate his mind on anything, and any attempt to do so brings on severe headaches. Gradually he recovers, but should be prevented from engaging in work requiring mental effort for some months. Occasionally he may have a tendency to fits, or the acuteness of his sight or hearing may be impaired.

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For purposes of illustration we have described a case which recovers, but sometimes the stage of reaction does not appear and cerebral irritation comes on.

Management.—The patient should be undressed and put to bed in warm blankets with hot-water bottles. The head is kept low and any scalp wound attended to, the hair shaved, the wound explored and treated. He is then left quite quiet, a record being kept of his pulse and temperature. If the concussion lasts some time, his water must be drawn off if it is not passed unconsciously. The urine should be tested at once for sugar and albumin, to make sure he is not suffering from diabetes or Bright's disease. Feeding may have to be carried out by the stomach or nasal tube, stimulants should not be given.

As soon as reaction sets in, he should be given a good purge. The vomited material should be shown to the doctor as it is sometimes important to know if he has been drinking alcohol. An ice-bag may be applied to the head and the patient disturbed as little as possible, so as not to increase his irritability. Relations should not be allowed in the room. All noise is avoided, the fire should be poked with a stick, and coal put on with the hand. Lights should be turned down and he should be left to recover. As he resents interference it is difficult to take his temperature, or to get him to take food. Food should be in the form of fluids, beef tea, milk, etc., and sometimes he will take this himself if it be left within reach.

Cerebral Irritation is the name often given to the state of cerebral irritability just described

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in those recovering from concussion, but it is here used to denote irritation or stimulation of the brain due to laceration from injury. In this state the cortex of the brain is injured and as a result convulsive movements of the face and limbs are seen on the opposite side of the body. If these are present they should be carefully noted by the nurse, as knowledge of the movements may help considerably in determining the extent and position of the injury. The patient lies in the same condition as in concussion, but can only be roused with difficulty; the pupils are often unequal.

Management.—This is much the same as in the early stage of concussion, except that it is more important to keep an hourly record at first of the pulse as the condition may really be the early stage of compression. If recovery takes place, the patient passes through the same sequence of events as in concussion. Convalescence, however, is often longer, and later there is greater liability to fits and mental impairment.

Cerebral Compression.—A patient may pass into this state from the states of concussion or cerebral irritation, or may recover from the temporary concussion, the result of a blow, and then lose consciousness and gradually pass through the stage of irritation to compression, or, again, he may be brought in with the condition after a severe smash of the skull. Compression may also rapidly arise from an attack of apoplexy or from the formation of an abscess or tumour in the brain. If the compression gradually develops as the result of injury the patient is unconscious, but in the early stages he can be roused temporarily. Gradu-

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ally the unconsciousness deepens till he cannot be roused at all. The pupils are unequal, but their state varies with the amount of the compression. There is usually well-marked cerebral irritation, the face and limbs on one side are twitched irregularly or may be held rigid; gradually this spreads to the other side, and the limbs which at first were convulsed now become limp and paralysed. It is, therefore, important to note the sequence of events. The pulse becomes progressively slower and from 100 at first it may sink to 50 or even lower still. The respirations, at first shallow and noiseless, become deeper and snoring in character. The snoring noise is made as the breath is drawn in and a blowing noise made as it is expelled, the flaccid lips and cheeks being blown out with the air. This form of respiration is called stertorous breathing. The temperature is subnormal. Later still the pulse quickens, becomes irregular and feeble and seems to run away, and the temperature may rise. The character of the breathing alters, and may become a series of groups of respirations. After a long pause, in which there is no breathing, shallow respirations are taken; these gradually deepen and then become shallow again, so that after about ten have been taken they die away again and there is another long pause, after which the sequence is repeated. This is called Cheyne-Stokes respiration or grouped breathing.

Management consists in keeping a careful watch on the patient and reporting at once any marked and steady fall in the pulse-rate, change in the movements of the limbs or the nature of the respirations.

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Compression after an injury to the vault of the skull demands immediate surgical operation, so that the pressure may be relieved either by elevating the depressed fragment of bone or clearing away the accumulating blood clot. After the operation, or when it is the result of fracture of the base of the skull or due to apoplexy where surgery can do little good, the patient should be kept with the head low, ice-bags may be applied after shaving off the hair, and the ordinary treatment of concussion adopted. Death very frequently ensues as the result of compression; if, however, recovery takes place the patient passes through the stages of irritability and later of fatuousness to recovery.

After such severe injuries, however, some mental defect very often remains permanently.

Meningitis is the inflammation of the meninges or membranes of the brain. Its most common cause is sepsis, which gains access through a wound such as a compound fracture of the vault or a fracture of the base, or from extension of disease in the bones of the skull, the commonest source of which is suppuration of the middle ear; it may also be caused by blood infection.

Symptoms.—These vary to some extent, but in acute infections from wounds or from the ear the onset is sudden. There is violent headache and vomiting, the temperature and pulse rise, and the patient may have a rigor. He is slightly delirious at night, becomes drowsy and begins to show signs of cerebral irritability, he lies curled up, avoids the light, resents interference and refuses food. After a day or two the drowsiness passes into unconsciousness and twitchings may be seen in the face

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or limbs due to the inflammation irritating the cortex of the brain. The temperature is high and irregular. Gradually symptoms of compression develop, the pulse-rate falls, the breathing alters, he passes his motions unconsciously, and either sinks gradually or dies in a convulsion.

Tuberculous Meningitis differs slightly from the last or septic form. The tuberculous variety is mostly seen in quite young children, and often in small babies. The disease is usually a part of a general infection of the body through the blood stream, but it may be an extension to the brain from a focus elsewhere. The disease is not so acute in its onset as the last form, the headache is accompanied by a peculiar cry, unconsciousness comes on with twitchings of the face and muscles. The attitude is often peculiar as the body is curved backwards, and the head fully extended so that the child looks up to the head of the bed. Squinting of the eyes is common. The abdomen is kept very rigid. The other symptoms are very much the same as in the septic form. Tuberculous meningitis runs a slower course and recovery is possible.

Fracture of the Vault of the Skull is usually the result of blows and falls on the top of the head. The injury varies from a crack in the bone to the depression of a large area with escape of injured brain matter from the wound.

The Symptoms of fractures of the vault are those of concussion, irritation or compression, while if sepsis gains access those of meningitis are added. Compound or depressed fractures call urgently for operation, the only exception to this rule being simple depressed fractures in young children. In them

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the bones are soft and very often the depression will disappear of itself.

Management.—In all scalp wounds the part should be cleaned with a strong antiseptic, the hair cut short and the head shaved for some distance from the wound, a preliminary dressing applied till the surgeon arrives. After operation where the brain has been injured, large quantities of fluid escape into the dressings, and additional wool has to be added in a few hours; it is best fixed to the head with a triangular bandage, the points being tied under the chin instead of over the forehead. A mackintosh should be spread over the pillow, under or over the pillowcase, to prevent the fluid soaking into the interior.

Fracture of the Base of the Skull may be the result of falls or crushes in which the fracture starts at one side and runs across the base to the other. It may also be due to falls upon the feet or in the sitting position, owing to the force being transmitted up the vertebræ to the under side of the skull. These fractures, as a rule, are mere fissures in the bone. Punctured fractures may be caused by sharp instruments driven in through the orbits, nose or mouth; the point of an umbrella has caused death in this way, while a child tripping with a pencil in its mouth may bring about a like fatality.

If a skull be held to the light, the floor is seen to be so thin as to be translucent in certain places, these areas are divided by two strong buttresses into three fossæ, anterior, middle and posterior fossæ.

Symptoms of fracture of the base are: (1) the

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escape of blood; (2) the escape of cerebro-spinal fluid and sometimes even of brain tissue; and (3) evidence of injury to some of the nerves. Bleeding may take place from the nose, the ears, or into the throat according as the anterior, middle or posterior fossa is involved.

In fracture of the posterior fossa bleeding may take place into the tissues of the neck, but the discoloration is only seen after the lapse of some days. If the patient is lying on his back, the blood from the nose and throat trickles back and is swallowed unseen, and large quantities of blood clot may be vomited later. After the bleeding has stopped a discharge of clear cerebro-spinal fluid may take place for some days from the nose or ears.

Of the nerves which may be affected the 7th and 8th are the commonest as they run for a considerable distance in the bone containing the organ of hearing. Deafness results from injury to the 8th and facial paralysis from injury to the 7th.

Fracture of the base is a most serious and fatal accident, as the brain is often lacerated by the force of the injury; there is every likelihood, too, of bleeding at the base of the brain causing compression.

Management.—The patient is brought in unconscious, and we will suppose he is bleeding from the ear. His clothes are removed and he is put to bed and treated as for concussion. His ears are washed free of clot, and the meatus syringed with 1 in 40 carbolic or 1 in 1000 perchloride or biniodide of mercury. Some boracic powder is shaken on a piece of sterile wool and put in the meatus. If sterile wool is not to hand, wool rung out in antiseptic must be used.

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A good pad of wool is placed over each ear and fixed with a bandage. The pillow is protected by a mackintosh, and additional wool got ready to replace the soaked dressings. The patient is then kept quiet, a record being kept of his pulse and respirations, the condition of the bladder must not be overlooked. Symptoms of compression and meningitis are to be feared, and a look-out kept for their onset, otherwise the treatment is that of concussion.

If the bleeding is from the nose or into the mouth the patient should be rolled on his side so that it trickles out into wool placed to receive it, and the clots cleared from the nose from time to time.

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CHAPTER XVIII

THE BODY TEMPERATURE

MAN, in common with birds and other mammals, is a warm-blooded animal, that is to say, his temperature remains at about the same level, 98·4° F.; all other animals are cold-blooded, their temperature varying with that of their surroundings. We all know that on taking violent exercise for any length of time we get very hot; it is also obvious that in cold surroundings we lose more heat than where the surroundings are warm. If, therefore, the temperature is to remain steady, there must be some mechanism which is constantly acting to keep the production and the loss of heat balanced. Let us see, therefore, how this balance is brought about, we shall then be in a better position to understand those diseases which upset the balance and alter the body temperature.

Heat Production.—The heat of the body is produced by the burning up of the carbon of the food by the oxygen of the blood; this takes place chiefly in the muscles, and to a less extent in the digestive glands. The production of heat is increased by using the muscles, as in walking and running, and by the activity of the glands after a meal.

Even when the muscles are apparently at rest they are maintained in a state of tone, which slight

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contraction is quite sufficient to produce the heat needed.

Heat Loss.—Heat is lost in a rather more complicated way from the surface of the body and from the lungs.

From the skin, the loss of heat takes place in two ways, by radiation and evaporation. In radiation the heat is passed into the air, clothing or any substance in contact with the skin. The amount will vary with the amount of blood which is passing through the skin capillaries and so cooled by this exposure. After active exercise, when more heat has to be lost, the skin becomes red with enlarged capillaries, while on a cold day, when the heat has to be conserved, the skin becomes white and pale, the blood being kept in the interior of the body.

Evaporation on the skin is the evaporation of the sweat. Sweat is always being secreted, but is evaporated insensibly. If a cold metallic or glass surface is touched by the fingers, the moisture will be seen condensing on it. This is called insensible perspiration.

If the amount of perspiration is increased so that it cannot be evaporated at once, beads of moisture appear, this is called sensible perspiration.

A large amount of heat is needed to turn water into vapour, and this heat is abstracted from the skin, so that a larger amount of heat is lost in this way; the amount can be varied with the amount of perspiration secreted.

In the lungs heat is lost in the same two ways. The cold air is taken in, and warmth is abstracted from the blood to heat it, and it is sent out warmed

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to the body temperature. The quicker one breathes the more heat one loses.

Evaporation also takes place in the lungs, so that the air is sent out saturated with moisture. In animals which do not sweat the lungs are the main channel through which heat can be lost—hence the rapid panting of dogs in hot weather and the lolling out of the tongue to increase the wet area from which evaporation can take place.

We see, then, that we have a balance, with heat production on one side and heat loss on the other, and that both of these can be varied. The brain controls this balance.

If impulses are sent down to the muscles to work and produce more heat, impulses are also sent to the sweat glands to secrete more fluid for evaporation, and at the same time impulses pass to the blood-vessels supplying the skin so that they dilate and allow more blood to pass through the capillaries of the skin. If, on the other hand, we have lost too much heat, as in bathing in cold water, then the muscles must work to produce more heat, and they do this by involuntary contractions which we call shivering, so that the balance still remains true at 98·4° F.

The Fevers.—Certain conditions, however, upset this balance at once, and send up the temperature, and these we call fevers; a moderately high temperature will be about 102° F. to 103° F., a high temperature above this level, while above 105° F. is a very high temperature, or hyperpyrexia.

In all feverish states where the body temperature is maintained for any time at a high level, the increased amount of heat produced means increased

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use of the muscles, although the patient may be lying in bed. Great muscular weakness results, the muscles waste rapidly and the body loses weight. In very high temperatures the heat loss is decreased, as the skin does not sweat; the temperature will be reduced if sweating occurs. In some diseases the sweating is profuse, and the patient must be warmly clad and have his damp garments changed, to prevent him losing heat too rapidly and thus throwing an additional burden on the wasted muscles.

Clinical Terms.—Names are applied to fevers of special types, many of these types being characteristic of the disease which causes them. Continued fever runs a prolonged course with a steadily raised temperature and a few remissions. It is said to be remittent when, though remaining above normal, the temperature rises and falls a certain amount each day. Intermittent or recurrent when the temperature, after remaining normal for some days, rises suddenly for a time and then resumes the normal, this being repeated again and again. A sudden rise of temperature, accompanied by a feeling of cold and shivering (followed by profuse sweating), is called a rigor.

In certain fevers the temperature rises to its height, and then remains steady for a certain time, which varies with, and is characteristic of, that particular fever, seven days in pneumonia, fifteen days in typhus. The temperature then subsides in one of two ways, it may either fall gradually a little lower each day, till it reaches the normal, in which case it ends by lysis—typhoid fever ends in this manner; or it may suddenly fall in the course

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of twenty-four or thirty-six hours, by what is called crisis—pneumonia and typhus are typical examples of this.

A hectic temperature is a septic temperature, and signifies one which rises to a height, say 103 to 104, in the evening and falls in the morning to about 100; the fall is accompanied by great sweating, the face is pallid with a pink flush on the cheeks, and the wasting and prostation are extreme.

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CHAPTER XIX

THE INFECTIOUS FEVERS

THE infectious fevers are diseases which are easily communicable to people who are not protected against them by a previous attack or by some form of vaccination. The modern view is that they are all caused by different forms of bacteria, this we know to be the case with some, but in others, like measles and scarlet fever, the organisms have not yet been detected.

Infection includes all possible means by which a disease can be conveyed from one person to another. *Contagion* is only one form of infection—that by direct contact. The infectious fevers are not all carried in the same manner with equal ease, thus diphtheria and measles are carried by the breath, scarlet fever by the discharge from the nose and ears, typhoid and cholera by the discharge from the bowels, and smallpox by the skin.

Prevention and Isolation.—On the outbreak of an infectious disease the first thing to do is to try and prevent it spreading to the remainder of the community. With the first case it may not be possible to diagnose the condition till some risk of spread has already occurred, but during an epidemic suspicion is at once aroused, and as soon as a person begins to feel ill he should be isolated. If

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an infected person can be removed to a hospital, sanatorium or house set apart for such cases, isolation can easily be carried out; but in a private house there is great difficulty in taking adequate precautions. In private the infected person should be nursed in the most secluded part—a room at the top of the house or in a partially detached wing, the rooms near by being vacated for the time. All unnecessary hangings, carpets and furniture should be removed from the room previous to the patient taking possession.

The attendants on the sick man should be the only ones given admittance, and they, in their turn, should hold themselves as much aloof from the rest of the household as possible. It is better if the attendants have suffered already from the disease, as they will then be less likely to take it. The crockery and utensils should be kept exclusively for the use of the patient, and should be washed by the attendants and not mixed with those used by the rest of the house. The food should be left at the end of the passage, and carried from there to the patient by the attendant. In these ways it is hoped to prevent the infection spreading.

Disinfection means the destruction of the organisms which have been shed off from the sick person. It is necessary to disinfect everything which has come into direct or indirect contact with the infected person, including his personal clothing and bed, his room and all its fittings and utensils. Besides disinfection after use, precautions should be taken to lessen the amount of infection during occupation by means of light, ventilation and antiseptics.

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Rules for Disinfection—

1. The room, while in occupation, should be kept well ventilated by opening the windows—there is no fear of infection blowing about in the fresh air. A fire should be kept burning if the weather is cold. The floor may be sprinkled with an antiseptic fluid each day before it is swept out. The door should be kept closed and covered with a sheet damped with 1 in 40 carbolic or other antiseptic.
2. All soiled bed and body linen should be soaked for an hour in a solution of perchloride (1 in 1000) before being sent to the laundry, or carbolic 1 in 20 can be used, but it is more expensive.
3. All discharges from the patient, sputum, vomit, urine and fæces, should be received into vessels containing some disinfectant, carbolic or perchloride. After emptying, some more disinfectant should be added.
4. Cups, plates, knives and forks used by the patient should be boiled. Hairbrush and comb put in 1 in 20.
5. All useless rags, books, toys, etc., should be burnt.
6. The patient should not be allowed to mix with others till he has received special leave from the medical attendant, and only then after a hot bath, in which he is thoroughly washed, including his hair. After the bath he dresses in a complete change of clothing.
7. Bedding, curtains and all articles which cannot be disinfected easily at home will be removed

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by the public health authorities if application be made in the proper quarter, and will be dealt with in special apparatus provided for the purpose.

8. To disinfect the room and furniture—
   (*a*) Carpets, curtains, hanging—spray with formalin solution and remove to outer air, dry and beat well before returning.
   (*b*) Ceilings, walls—spray with formalin solution.
   (*c*) Bedsteads, tables, chairs, floors, and woodwork generally—scrub with cresol solution.

The diseases commonly classed under infectious fevers in this country are—chickenpox, measles, german measles, scarlet fever, whooping-cough, diphtheria, mumps, typhoid, typhus and small-pox. In this list whooping-cough is included as it is so closely associated with measles and scarlet fever. In nearly all infectious diseases there is a period of quiescence after the organism has entered the system, called the *incubation period*, during which time nothing appears to happen. This incubation period is of definite length, differing with each organism. At the end of this period the *invasion* of the fever commences with symptoms of varying intensity. In very slight cases there may only be headache, chilliness and a feeling of general malaise, in more severe cases there is vomiting, a rigor, and, in children, convulsions; the rash will appear as a rule in the next twenty-four or forty-eight hours. Children are much more frequently attacked than adults, but often adults present severer symptoms.

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Chickenpox, or Varicella, is one of the mildest of infections, and is rarely seen in any but children. The incubation period is eight to sixteen days. The invasion is very mild and may escape notice. The eruption appears as small vesicles on the face, chest, trunk and upper parts of the limbs. They often appear in crops on successive days, each crop lasting about four days. The fluid in each vesicle is at first clear, then turns milky; it is discharged as the vesicle bursts, a scab then forms and the sore heals over. If the vesicles are scratched and made septic serious, permanent scarring may result. The disease lasts about fourteen to twenty-one days.

Management.—So mild is the disease that very little special treatment is ever required. The child should be kept in bed on a light diet, so long as the crops are appearing or the temperature is raised. The nails should be cut to prevent scratching and picking the scabs. The children should, of course, be isolated from other children.

Measles, though looked upon as quite a mild disease, varies in its intensity, in some epidemics the mortality and consequences both from the disease itself and from sequelæ may be very severe. The incubation period is definitely twelve to fourteen days. The invasion period is marked by the symptoms of a severe cold, sneezing, running from the eyes and nose, an irritable cough, with a patchy, spotty appearance of the mucous membrane of the mouth (Koplik's spots). It is unfortunate that the diagnosis cannot be made with certainty at this stage, as the patient is in a most infectious state, and all children he is in contact with should be watched carefully for symptoms twelve days later.

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The invasion is accompanied by a temperature of about 101 to 103, and vomiting usually occurs. On the third or fourth day the rash appears as small red blotches, star or crescent shaped, and slightly raised. They appear first on the neck and behind the ears, and from there spread over the whole body.

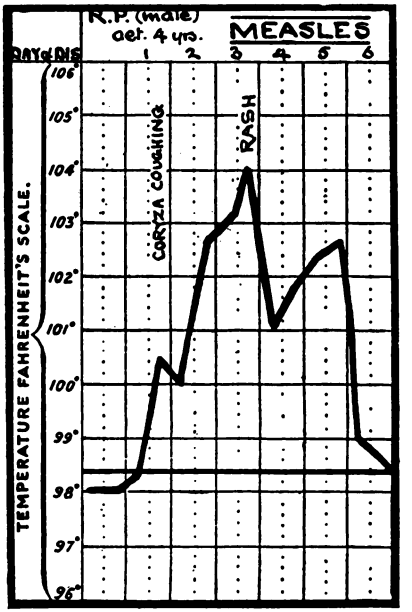

FIG. 84.

Fresh spots may appear on successive days. With the appearance of the rash the temperature suddenly falls by crisis, and the child feels better. Slight branny desquamation follow for about ten days.

Children may take measles two or even three times.

Complications.—In severe cases the temperature may run up to a great height and severe prostration

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result. The commonest complication, however, is the spread of the catarrh down the trachea and bronchi to the lungs, where serious bronchitis and pneumonia may be set up; this may be followed later by whooping-cough, and if the lungs do not clear up, tuberculosis may ensue. Inflammation of the ear, with ear-ache and discharge, is quite common, while occasionally there is diarrhœa.

Management.—The close observation of children who have been in contact with a child in the catarrhal stage has already been referred to, and is most important if the outbreak is to be controlled. The affected child should be put to bed and clothed in flannel, great care being taken to prevent chills. A cough mixture is usually given, and if lung complications ensue, special treatment and care will be needed, so that the lungs clear up completely before the child passes from under medical supervision.

Ear-ache is best treated by hot boracic fomentations, and sometimes by puncture of the drum. (See *Ear.*)

Scarlet Fever or Scarlatina is a disease of children, and also of young adults, if not protected by a former attack. The incubation period is short, three to five days. The rash appears on the second day. The invasion is sudden, and often severe, usually marked by rigors, vomiting and sore throat. The rash is made up of fine red points so close together that the whole skin looks bright red, and gives to the hand a burning hot feeling. The rash appears first on the chest and flexor aspects of the joints, but is generalised in about forty-eight hours, and fades in about a week, though the person is not considered cured till at least six weeks have

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elapsed. The throat symptoms increase, the fauces become dark red, the tonsils become covered by yellow spots, marking the mouths of the crypts. The tongue becomes white with a thick fur, through which the swollen and red papillæ show up, like the surface of a strawberry, hence the term strawberry tongue. The temperature, which is high at first, comes down slowly in the course of a week. Peeling begins on the chest and trunk, and is followed later on the limbs; it used to be thought that the stage of desquamation was highly infectious, much less importance is attached to it nowadays.

Complications.—In severe cases the disease may prove rapidly fatal, the temperature rising to over 105, delirium or coma preceding death. In other cases, the throat symptoms may become so severe that ulceration may take place, and sloughing patches appear on the tonsils. Severe toxæmia may follow, with suppuration, and the formation of abscesses in the glands of the neck. Sometimes suppuration takes place in joints, septic organisms being carried there by the blood. Sepsis may spread from the throat up the auditory tube to the ears, which may be severely affected if left untreated. Pericarditis, pleurisy and rheumatism may all be found in severe cases. The commonest complication, however, associated with scarlatina is undoubtedly inflammation of the kidneys, with albuminuria and dropsy, which may appear during convalescence even in the mild cases.

Management.—Strict isolation should be insisted upon immediately there is any suspicion of this disease. In mild cases no particular treatment is necessary, the fever runs its course; the diet should

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be light and little meat given, so as not to throw extra work on the kidneys. In the severe throat cases, the mouth should be washed out with an antiseptic mouthwash, which should be gargled if

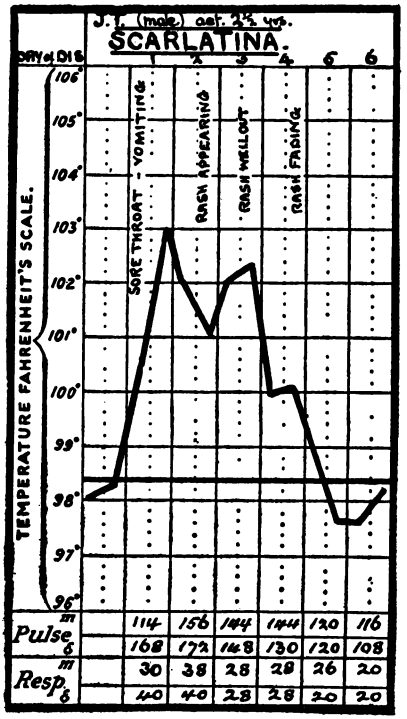

FIG. 85.

the child is old enough. Pieces of ice may be given to suck, and warm antiseptic inhalations used, so as to decrease the amount of toxin absorbed. Hot fomentations to the neck are useful if the glands are very inflamed.

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The Diet should consist wholly of milk and milky foods, bread and butter, custard, porridge, milk puddings of all sorts. Alcoholic stimulants are rarely needed, tonics containing strychnine are often ordered.

During convalescence the diet, though more liberal, consists still of the same constituents, very little meat being given for fear of kidney complications. For the same reason hot baths should be given twice a week, so that the skin acts freely. The child must be warmly clad, and not allowed to get out of bed and romp about for fear of catching a chill. A specimen of the urine should be put out and tested each day for albumin and blood, which would show the onset of nephritis. If no specimen is put out, gastric disturbances or swelling of the eyelids, especially on waking, should at once arouse suspicion. During desquamation, hot baths are useful in helping to remove the skin, especially if a rough soap be used. Though it is now recognised that the discharges from the nose and ears are more infective than the peeling skin, it is unwise to let patients mix with other children till the peeling is over.

German Measles or Rötheln is a milder complaint than measles or scarlet fever, and is often very difficult to distinguish from the milder forms of these two diseases. The incubation period may be as long as three weeks. The invasion symptoms are mild, while the rash is less blotchy and redder than measles, and not so fine and less red than scarlet fever. The glands at the back of the neck are enlarged, but the throat is not sore.

The Management is the same as for ordinary measles, there are hardly ever any complications.

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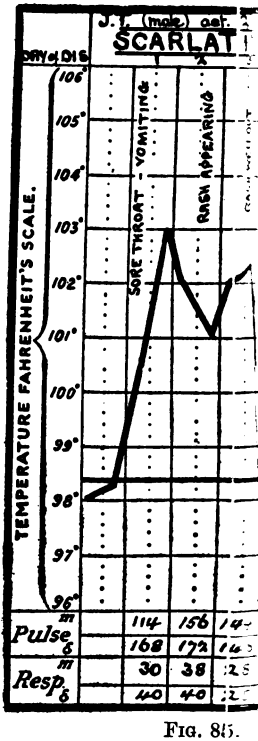

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Whooping-Cough, or Pertussis, is a highly infective condition, but like mumps has no rash. The exact nature and cause of its chief symptoms are as yet undecided.

The disease chiefly occurs in children under eight years old, and frequently follows other infectious diseases, such as measles and scarlet fever. The incubation period varies from four to fourteen days. The disease may be divided into two stages.

The first or catarrhal stage, which lasts about a week to ten days, during which time the child is out of sorts, his condition is marked by slight rise of temperature and a hoarse cough and symptoms very like a common cold. The second or paroxysmal stage. Gradually the cough becomes more pronounced and occurs in paroxysms, worse at night. During these paroxysms the face becomes red and the eyes suffused. Towards the end of the second week the whoop appears. A typical attack is as follows : there are a few rapidly given coughs, between which no breath is taken in, then there is long inspiration, accompanied by a whooping or crowing noise; this is followed by a larger number of short coughs, then a longer whoop, a third and fourth breath may be needed before the child is exhausted. The paroxysm terminates either by vomiting, or bringing up wind, and the spitting out of stringy mucus. During the paroxysm the face becomes congested, the eyes are starting, the tongue protruded, and towards the end the child is utterly exhausted. The children are in terror of the attacks, and often will run and clutch their mother or nurse when they feel one coming on.

In severe cases, the continual coughing and straining causes the face to become swollen and

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dull-looking, small blood-stains may be seen under the skin, and the eyes may be blood-shot from the same cause. An ulcer is often found underneath the tongue from the fretting of the frænum of the tongue on the front teeth during the coughing. Any sudden stimulus seems liable to set up the attack.

After two to four weeks the paroxysms become less in number and in severity, and the whoop occurs less frequently, until it ceases to be heard, though the cough may retain its paroxysmal character for some time. On the other hand, the whoop may last for months.

Complications are numerous, and the disease cannot be looked upon as being without danger, as the mortality of 1 in 10 will show. Bleeding may take place from the nose, the lungs or from ulceration of the tongue. Convulsions are not uncommon in very young children, and are always serious. Broncho-pneumonia is common, especially in children who have just had measles, and, like convulsions, is of grave importance. Among rarer complications are laryngitis and hemiplegia; the latter is the result of rupture of a vessel in the brain during a paroxysm of coughing.

Management.—During the early stage of the disease the child should be treated in the same way as for a common cold. In all probability this is the only infectious stage. In the early part of the paroxysmal stage the child should still be confined to bed, until one can be quite certain that the disease is only present in a mild form. After that there is no reason why the child should not be allowed up, though confined to the room. The whooping period need not be looked upon as infec-

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tious once the catarrhal stage is really passed. In the way of treatment there is little we can do that will cut short the disease, but the complications need careful attention. (See *Convulsions*, *Pneumonia*, etc.) In chronic cases, which continue to whoop occasionally, nothing is so beneficial as change of air. The feeding must always be carefully attended to. A little food should be given frequently, as children often become extremely emaciated during this disease, for though they may eat sufficiently at set meal-times they probably vomit their food at the next paroxysm and thus derive no benefit from it. The consequent lowering of their vitality has a good deal to do with the frequency with which tubercular troubles follow after whooping-cough.

Mumps, or Epidemic Parotitis.—This disease is very infectious among children unprotected by a previous attack. The incubation period is about three weeks, and the invasion symptoms are mild. There is swelling of the salivary glands, especially the parotids, one side becoming infected is followed in a day or two by swelling of the other. The swellings give a peculiar rounded appearance to the face. Swallowing and chewing are painful, and the patient is unable to open the mouth on account of the pain.

Management.—The patient should be isolated at once. Hot fomentations to the side of the face relieve the pain. The mouth should be washed out with an alkaline mouthwash (bicarbonate of soda, 10 gr. to an ounce of water) to loosen the thick mucus from the ducts. Draughts and chills are to be avoided. Inflammation of the generative organs,

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the ovaries and testis, may occur, and sterility may result. The general health is often lowered for some time after the disease. The patient remains infectious for a very variable time, and this, together with the long incubation period, makes the disease most annoying, as it may show itself in another member of the family a month or more after the patient is apparently cured.

Diphtheria is a highly contagious disease caused by the Klebs-Lœffler bacillus, which sets up an acute inflammation of the mucous membrane of the throat (rarely of the skin), in which patches of white membrane appear on the tonsils, palate and fauces, and may spread into the nose, the larynx or œsophagus. The membrane is composed of the dead cells of the mucous membrane, held together by coagulated lymph; it swarms with bacilli. Diphtheria is often associated with damp houses and insanitary methods of drainage. The incubation period varies from one to seven days. The invasion symptoms may be so slight as to escape notice till the condition of the throat attracts attention, but as a rule they are severe. There is fever, vomiting and a feeling of intense lassitude, small children rapidly assume an appearance of great toxæmia and weakness.

The throat rapidly becomes stiff and sore, swallowing is difficult, and a white patch is seen upon the tonsils, palate or uvula. The throat is red and the tonsils swollen. If the membrane is first seen on the tonsils, it rapidly spreads on to the neighbouring palate, so that it is easily distinguished from a septic tonsillitis. There is some swelling of the glands of the neck under the angle of the jaw. In

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severe cases death may follow in a few days from toxæmia. The temperature as a rule falls to normal in a few days, but in severe cases, with great depression, it may sink to below normal, so that a low temperature must not be taken as evidence of a mild attack.

Complications.—Laryngeal Diphtheria is the spread of the membrane into the larynx; it is to be feared most in small children, in whom the air passages are so small that swelling of the mucous membrane and the presence of the diphtheritic membrane soon produce great obstruction to the breathing. This extension may take place rapidly during the night time, and urgent symptoms suddenly arise. These symptoms are easily recognised. The cough changes its character and becomes croupy and stifled. The voice or cry becomes hoarse, or may be lost altogether, the breathing is noisy and crowing, especially during inspiration, which is only performed with difficulty. If the chest is uncovered and the movements observed, the lower ribs are seen to be drawn inwards by the powerful contractions of the diaphragm. If this continual effort is allowed to persist, it will rapidly exhaust the child's strength, it calls urgently for relief by intubation or tracheotomy. As the difficulty of breathing increases, the lips become blue, and the child becomes drowsy and unconscious.

Nasal Diphtheria is the spread of the disease to the mucous membrane of the nose; it is shown by the increase in the discharge from the nostrils and the increased prostration and weakness.

Another very severe accompaniment of the disease is *cardiac weakness*, as the toxin of the

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disease has the power of injuring and diminishing the power of the heart muscle. This may be seen any time after the first week: sudden and fatal syncope is not uncommon in those who are allowed up too soon. *Acute nephritis* may be set up by the toxins, and the urine contain albumin and sometimes blood.

Management.—The child is put to bed at once and kept lying flat on the back; in severe cases the head should be kept low, in mild cases a small pillow may be allowed. Sitting up or standing in bed after the severe symptoms are over are strictly forbidden.

The local treatment consists in painting or swabbing the membrane frequently with an antiseptic solution ordered by the doctor. As manipulations at the back of the throat are liable to induce coughing, the nurse should take care that the infection does not reach her; veils or gauze masks are sometimes worn for this purpose. At the earliest possible opportunity the doctor will inject a dose of diphtheria antitoxin, and this will be repeated next day if the membrane shows any disposition to spread. When the severer symptoms are passed, it is very usual to order small doses of strychnine in stimulants to be given every four hours, on account of the weakness of the heart.

The child should be encouraged to take its food, which will consist of milk, gruel and arrowroot. The bowels must be kept open, and a specimen of urine put aside daily for testing. In an ordinary case with no heart symptoms, an extra pillow may be allowed at the end of a fortnight or three weeks, and a second and a third pillow at intervals of a

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week, so that at the end of four or five weeks the child is sitting up in bed. If a rise of temperature takes place, a look-out should be kept for a rash due to the injection of antitoxin. These antitoxin

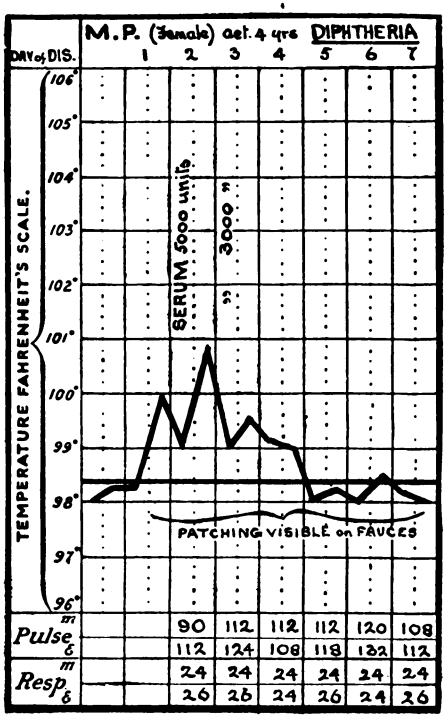
M. P. (female) aet. 4 yrs DIPHTHERIA
DAY of DIS. 1 2 3 4 5 6 7
TEMPERATURE FAHRENHEIT'S SCALE.
106° 105° 104° 103° 102° 101° 100° 99° 98° 97° 96°
SERUM 6000 units.
3000
PATCHING VISIBLE on FAUCES
Pulse m 90 112 112 112 120 108
Pulse e 112 124 108 118 132 112
Resp m 24 24 24 24 24 24
Resp e 26 26 24 26 24 26

FIG. 86.

rashes usually appear within a fortnight of the injection, but may be delayed longer.

Taking a Culture from the throat is necessary in order that the bacilli may be seen under the microscope. For this purpose sterile tubes are prepared, in which there is a piece of stick about five inches

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long, the handle end of which projects through the piece of cotton-wool which closes the mouth of the tube. To the opposite end of the stick is attached a small sterile swab. The child is taken and a blanket wrapped round it so as to imprison the arms. The head is held steady by an assistant. The stick is withdrawn from the tube, and the tongue depressed with a spatula, the swab at the end of the stick is then rubbed lightly over the membrane and returned at once to the tube. The patient's name and the date are written on a tag and attached to the tube, which is sent off immediately for examination.

A definite reply can often be obtained by examining at once, but it is usual to replant the organisms on a tube of culture medium, which is placed in an incubator for twelve hours, at the end of which period the characteristic growth can be examined.

Tracheotomy.—If this becomes necessary, the nurse should prepare the following things—

1. An operating-table, which can be improvised out of a dressing-table or a chest of drawers, the height of the latter being rather an advantage. It must be arranged so that there is ample light—daylight if possible.
2. A small firm roller or sand-bag to go under the neck.
3. A blanket and mackintosh to cover the table, a small blanket to wrap round the child.
4. The tracheotomy tube must be "mounted" by passing the end of a narrow piece of tape through the slits in the wings of the outer tube, and tying them so that the knot is

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some distance away from the tube. The tape on each side should be long enough to go twice round the neck, as they can then be tied easily on the side which proves most convenient.

FIG. 87.—Tracheotomy Tubes.

5. The feathers used should be looked at to see that they are not broken and have no loose barbs.
6. In hospital the nurse may have to see about the instruments and the apparatus for giving chloroform.

During the operation the nurse will often have to assist the surgeon in sponging.

Care of Tracheotomy Cases.—The nurse must realise that the child can never be left alone, as blockage of the tube, even for a few minutes, would prove fatal. After the operation the relief given to the exhausted child enables it to pass some hours in deep sleep. The nurse should make herself thoroughly familiar with the particular form of the tracheotomy tube used. Tracheotomy tubes

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consist of an outer and an inner tube, the latter being slightly the longer, and is loose, while the former is secured in place with tapes round the neck. The outer tube should not be removed except by the surgeon. The inner tube may get partially or completely blocked by mucus or membrane, and when this happens it should be removed and cleaned. It should be removed in any case every four hours, washed in an alkaline lotion, and a feather run through it to make sure it is clear. The mucous discharge is wiped away from the mouth of the tube with gauze, which is then burnt, but gauze or lint should not be laid over the opening, as it will become moist, and may be sucked in and prevent the entrance of air. On a small table near the bed there should be (1) a bowl of antiseptic solution, in which a spare inner tube lies ready for insertion when the one in place has to be removed; (2) a bowl with alkaline solution, with some feathers; (3) a pair of scissors and tape; (4) a probe; (5) tracheal dilator and tracheotomy guide, in case the outer tube slips out; (6) a spatula; (7) a collection of cut pieces of linen or gauze to wipe away secretions. Great care must be exercised to see that the instruments are kept sterile, if possible there should be a small steriliser or means whereby the instruments can be boiled close at hand. The dressings of the wound are changed as needed. The outer tube may be removed by the surgeon, in which case another is slipped in at once. If all goes well the tube will probably be removed in less than a week, after which the wound closes very rapidly. The tube should never be kept in longer than is absolutely necessary.

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Paralysis.—Any coughing or choking during the taking of food should be reported at once, as this is often a symptom of commencing paralysis of the palate. If this occurs the food will be returned through the nose, there will be difficulty on swallowing, and the child is liable to get some down into the larynx and trachea. Sometimes broncho-pneumonia is set up by this means. Paralysis of the other parts of the body may also occur, such as the arms, legs or some of the muscles of respiration, the last of which may be very serious. With paralysis of the palate the voice takes on a nasal tone; explosive letters, such as *b*, *d*, *p*, *k*, etc., cannot be pronounced as the air escapes through the nose.

Typhoid or Enteric Fever is caused by the typhoid bacillus. The disease usually attacks young adults and sometimes children. Epidemics easily arise from defective sanitary arrangements, allowing the bacillis from one case to gain access to the water supply, the infected water being drunk by other people, or the water may be used to wash utensils used for eating. In this way the milk-cans of a dairy may be infected. The bacilli grow and multiply freely in milk, so that a large number of people may be infected from a single case. Improvement in our sanitation, and the strictness with which each case is isolated and disinfected, has practically banished the disease from our large towns. Any carelessness would, however, bring it back at once. Typhoid is a perpetual danger where sanitation is deficient.

The bacillus sets up inflammation and ulceration of the lymph tissue in the small intestine, especially in the large patches of lymph tissue known

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as the agminated lymph patches. The disease lasts three to five weeks. During the first week the lymph tissues become inflamed and swollen; during the next ulceration takes place, and a slough forms over the ulcer; during the third and fourth the slough separates, leaving the intestinal wall very thin. At this time hæmorrhage may take place from an ulcerated blood-vessel, or rupture of the floor of the ulcer may occur, with consequent peritonitis. If these misfortunes are avoided the ulcers gradually heal.

Symptoms.—The incubation period is about three weeks, towards the end of this time the patient feels generally ill and weak, especially towards evening. If the temperature is taken there will be found a slight rise. Next morning the temperature is down again, and the patient feels better. This goes on until the patient takes to bed, then, if the temperature is taken night and morning on several successive days, the morning remission will be found, but a gradually increasing height will be noted both in the morning and evening temperatures, this is very characteristic of the disease. The patient usually vomits once or twice, but may only feel sick. Bleeding from the nose is not uncommon. His tongue is red at the edges, but down the centre is thickly coated with a dark brown fur. He may look dull, but the colour of his face is clear, and his complexion is bright. The pulse and respirations are both slightly quickened and there may be a slight cough. There is diarrhœa, and the stools are peculiar. They are loose, watery, light brown in colour, and very offensive in odour. They are usually described as being like pea soup. The

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abdomen becomes slightly fuller than usual, and may be tender over the lower part. During the second week the temperature has reached its height, but still shows a slight morning fall. In this week, too, the rash appears in the form of a few rose-pink spots scattered over the abdomen, chest and back. They may be so few in number as to escape notice, unless looked for carefully. The spleen is enlarged and may be felt. The condition of the patient is one of extreme prostration, with slight delirium, and wandering especially at night. During the third or sometimes the fourth week the tongue begins to clean. The temperature begins to subside by lysis, it comes down as it went up, a step lower each succeeding day, till it reaches normal usually in the fourth week. Convalescence is slow and gradual.

Relapses.—Some days after the temperature has reached the normal and everything points to an uneventful recovery, in a small number of cases the temperature will start rising again, and the patient will pass through another attack of typhoid fever which runs the same course as the previous one. It is supposed that a fresh set of lymph nodules are attacked, and the whole fever is repeated usually in a slightly milder form. But, as the strength of the individual has already been sapped, he is likely to succumb from exhaustion. In very rare cases a third attack may follow the second.

The Complications of typhoid are all very serious, on account of the reduction of the patient's strength. They are to be looked for during and after the second week. *Hyperpyrexia* is sometimes seen, the temperature rising steadily to over 105; it is usually

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associated with restlessness and delirium, all of which produce extreme exhaustion.

Diarrhœa may be excessive, ten or more large watery motions being passed daily.

Hæmorrhage from the bowel should be reported at once, and is always alarming, as though small amounts may be passed with no ill consequences one can never tell that ten or fifteen ounces will not be seen next time. Severe hæmorrhage is often accompanied by a sudden fall in temperature.

Perforation and *Peritonitis* is recognised by sudden increase of pain and fulness in the abdomen, at the same time the abdominal walls become rigid and the pulse rises. This complication is almost always fatal unless surgical aid is at hand.

Bronchitis and *Pneumonia* take their origin from bronchitis which is often present and which is aggravated by lying upon the back. A pneumonic condition of the bases of the lungs may come on insidiously, and is recognised by unsteadiness of the temperature chart, increase in respiration, blueness of the lips, coughing and pain in the chest, later there is coloured sputum.

Bed-sores are very apt to occur, on account of the complete helplessness and extreme weakness of the patient, which prevent him moving from one position.

Management.—In no disease do the possibilities and importance of good nursing reach a higher level than in typhoid fever. The competent nurse can manage her patient in such a way that the risks of complications are greatly diminished, and so conduce to a safe recovery. On the other hand, careless nursing, clumsy manipulations and move-

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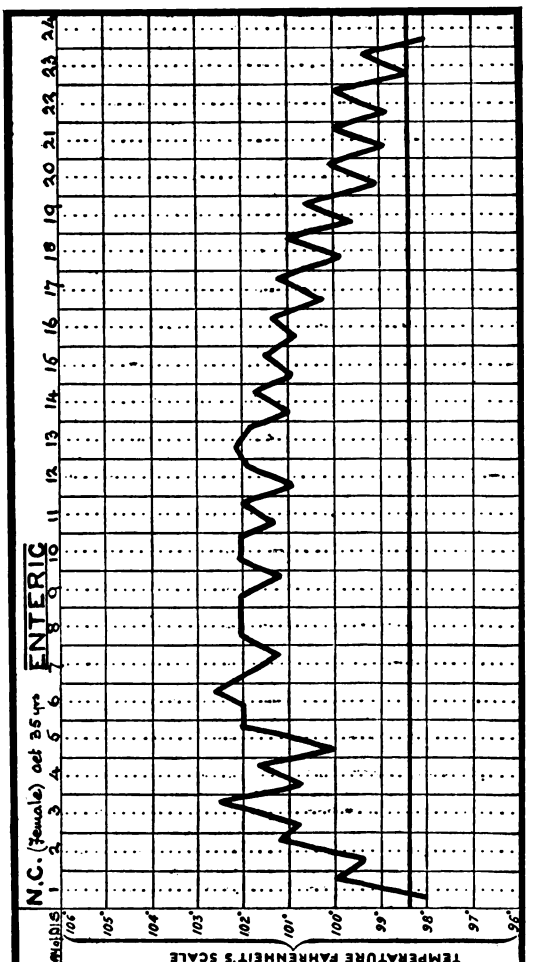

FIG. 88.

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ments may set up hæmorrhage, or actually cause rupture of the ulcer, and so sacrifice a life. The importance of good nursing in typhoid cannot be over-rated.

If seen in the early stages the patient is put to bed after a hot bath, or if too ill to be bathed he may be sponged with soap and hot water. It is often advisable to cut the hair of a girl quite short at once; if consent is not obtained for this, the hair must be carefully plaited in two plaits. In doubtful cases a careful examination should be made for spots, and those present should be noted or marked, to distinguish them from those appearing later, and the doctor's attention should be directed to them. In private, if a water-bed can be obtained, it should be used from the early stages, in hospital they are reserved for the severe cases.

Nursing consists in ensuring during the whole course of the disease: (1) absolute rest; (2) suitable feeding; (3) a proper amount of sleep; (4) conserving the strength of the patient by promoting bodily and mental repose in every possible way. It is only rarely that drugs, except stimulants and hypnotics, are given to typhoid patients, as they have no effect on the course of the disease.

1. *Absolute Rest* in the recumbent position is maintained all through the disease. Though the disease is not so infectious as scarlatina and measles, visitors should not be allowed. All movements, such as rolling or lifting the patient, should be performed with great gentleness and deliberation, especially during the second and third weeks. One nurse should always get another to assist her to lift an adult, and should not attempt to do so by

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herself; the patient should be put to as little effort as possible.

Sitting up during the latter half of the disease by patients who have had mild attacks is strictly forbidden, sudden fatal perforation may occur.

2. *Suitable Feeding* is necessary to maintain the strength, as exhaustion and emaciation are such prominent features of the disease. At the same time, owing to the ulcerated condition of the bowel, it is important that no hard or indigestible material be allowed to pass over and injure the ulcerated surface. The diet, therefore, is restricted to milk, which is given in small quantities frequently throughout the day and during the wakeful periods of the night. Four to six ounces may be given to an adult every two or three hours, so that there is no difficulty in giving two to three pints in the twenty-four hours. The milk may be boiled, but is better sterilised, and may be diluted with water, soda or barley water if the thirst is great and the mouth dry. A careful watch must be kept on the stools, for the passage of curds of undigested milk, which is evidence that too much is being given. Some people cannot take milk, and in these peptonised milk or whey may be tried, or veal, beef or chicken tea substituted for some of the milk feeds. Nutrient enemata may have to be resorted to when the loathing of food is great. The issue may depend on keeping up the strength, here stimulants are useful.

During the night natural sleep should not be broken in order to feed at exact hours, but in severe cases the condition of stupor in which patients lie need not be respected in the same way.

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In the later stages of the disease, when the ulcers are healing, the temperature is lower, and the patient is feeling better, the craving for food is as difficult to combat as was the previous loathing. At this stage, patients cannot be trusted, they will try and coax the nurse or bribe the attendants to allow them a little solid food. The feelings of friends may be more easily worked upon to the same end, as they are ignorant of the dangers involved. In consequence, a sharp look-out is needed to see that visitors do not smuggle in undesirable food, which may cause a sudden perforation and death. The temperature is the best guide as to when to give solid food, it is wise to wait until the temperature has been normal for a week. After this the usual diet ladder may be climbed.

3. *The Proper Amount of Sleep* is obtained without difficulty, except in the severer forms of the disease. Natural sleep should not be disturbed for feeding or other reasons unless there is great necessity. Sleep can often be induced by a hot feed or a little alcohol added to the milk. If the temperature is high tepid sponging will often induce sleep. Where there is real sleeplessness, hypnotics must be used; among the commoner drugs are chloral, paraldehyde and veronal.

4. *Conservation of the Strength of the Patient*, by promoting bodily and mental repose, is helped by forbidding the patient to take part in any business transactions, and trying to get him to lay aside his mental worries for the time being. Ill news should not be communicated to typhoid patients until nearly well. Bodily repose may be aided by many small nursing attentions, care should be taken of

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the wrinkles in the sheet, the state of the pillows, the dryness of the mouth, the blockage of the nose, the irritation of flies, all of which may be very wearying to a helpless person.

The Excreta.—As the bacilli which cause the disease are contained in the motions and in the urine, the greatest care is necessary in dealing with these. All excreta should be mixed with about four times their bulk of disinfectant, corrosive, carbolic or cresol, and left standing for at least half-an-hour before being emptied. The tow or wool used to wipe the patient must be burned at once.

Where many patients are being nursed together all the utensils used by those suffering from enteric should be marked "E," and kept apart and not used for any patients not suffering from this disease. The same applies to the body and bed linen, towels, etc., used by enteric patients. Everything used by these patients should either be boiled or placed at once in an antiseptic. The nurse, after attending to an enteric patient, should wash her hands and rinse them in an antiseptic. If these precautions are taken, there is very little danger, either to the nurse or to other patients in the same ward.

If the diarrhœa is excessive the patient rapidly loses strength. To check this opium is often given by the mouth, and sometimes in the form of a starch and opium enema. Sometimes the food can be diminished with benefit. Constipation is sometimes present in mild forms or during convalescence, an oil enema is usually all that is needed; sometimes a little calomel is given by the mouth, but no drugs should be given without the order of the doctor.

Complications.—High Temperatures are more ex-

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hausting than moderate ones, they also induce sleeplessness and delirium, it is therefore advisable to keep the temperature within limits. This is done by sponging with tepid water, to which a little spirit has been added, or by a cold pack, or actually by a cold bath. In the latter case a special bath is wheeled to the bedside and the patient gently lifted on to a board, which can be lowered slowly into the bath. Experience is needed so that the reduction of temperature is not overdone. (See *Cold Pack.*)

Hæmorrhage and *Perforation*, if suspected, should be reported at once. The former is nearly always detected soon after it has occurred by the blood passing from the bowel; perforation, on the other hand, may not be noted till peritonitis has started. Both are often accompanied by a fall in the temperature. Opium is usually given for the former, in the latter surgery is the only hope.

Pneumonia is dangerous, especially when associated with great prostration—(see *Pneumonia*)—stimulants are beneficial.

Convalescence.—During this time the temperature should be recorded night and morning, as relapses may occur at variable times, but usually within fourteen days of the temperature standing at normal. When the patient is first allowed up he should not attempt much, as thrombosis of the veins of the leg and thigh is a common occurrence, especially on the left side. If this takes place the temperature may and usually does go up for a few days. The limb becomes swollen and very painful, and the veins hard with clotted blood.

The patient should be put to bed, the limb

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swathed in cotton-wool and bandaged and raised upon a pillow. Movement should be avoided, as there is a risk of a clot becoming dislodged as an embolus, blocking the pulmonary vessels and causing sudden death. The limb sometimes takes a long time to recover, and varicosity of the superficial veins may result from the obliteration of the deeper ones.

As convalescence proceeds the diet may be varied as the appetite is extremely good, as a rule the gain in weight is astonishingly rapid; the patient two months after his attack may be considerably heavier than he was before.

Cholera.—Though rarely seen in Great Britain, it is common enough in many other parts of the empire, and is now and then imported through one of the seaport towns. It is common all through the tropics. The germs of the disease are usually taken in by eating contaminated food, such as over-ripe fruit, or by drinking water.

Symptoms.—The onset of the disease is of great suddenness, but it may be preceded by slight gastric disturbances. The disease may be divided into four stages.

The *first stage, or invasion*, consists in the premonitory gastric symptoms, usually diarrhœa and nausea.

In the *second stage* the diarrhœa becomes extremely violent, the stools no longer contain anything solid, but consist of a whitish fluid like rice water. At the same time there is urgent vomiting, with cramps in the muscles of the limbs and abdomen. The thirst is intense, and in a few hours the voice becomes weak and husky, the face falls in, and the eyes become sunken. The whole of this stage only lasts

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a few hours, twelve to fifteen at the outside, when the patient gradually passes into the *third stage* or *stage of collapse*. The temperature is now subnormal, the vomiting and purging have ceased from weakness, the skin has assumed a dull leaden hue, and is covered with perspiration, the face is emaciated, and the voice gone or sunk to a whisper. Death may ensue in twenty-four hours from the commencement of the attack.

The *fourth stage* is only seen in favourable cases, it is the stage of reaction which heralds recovery. The pains get less, the pulse recovers its strength a little, and the breathing becomes easier. The nausea has passed, and the patient is enabled to take a little fluid nourishment given at short intervals. Later on he can be allowed to drink bland fluids more freely as the thirst is intense. The kidneys, which have been secreting no urine for some hours, will then begin to act.

Management of cholera cases is very simple, the issue, unfortunately, rests more upon the severity of the disease and the strength of the individual than upon anything we can do.

At the first premonitory symptoms the patient should take to bed and abstain from all food. Small quantities of fluid may be allowed to relieve the thirst. Counter irritation to the stomach may relieve the depression caused by the vomiting. Warmth and friction may relieve the cramping pains. During the stage of collapse every effort should be made to tide the patient over till reaction can take place. Hot blankets, hot bottles, brandy and hot drinks if he can take them, or if the diarrhœa has stopped, saline may be given per rectum.

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Subcutaneous or intravenous injection of saline is very useful at this stage, and quickly replaces the fluid drained from the tissues.

Those nursing cholera patients should remember that the spread of the disease is very similar to that of typhoid, and that the same precautions which should be taken in the latter are ample for the former. In addition, personal health should be attended to by regular meals, sufficient sleep, and not too long hours of attendance. People are extremely apt to let their fears get the better of them during the panic of a cholera epidemic, and may imagine that vague uneasiness is the onset of the disease. It is extremely important to reassure such people, and to prevent those that are inclined that way from indulging in alcoholic stimulation.

Typhus, the fever, gaol fever, or putrid fever—it was well known formerly by all these terms—is now practically banished from Great Britain. It is a disease which results from overcrowding, destitution and starvation. It is therefore still found in places where these conditions exist.

Symptoms.—The onset as a rule is sudden—vomiting, rapid pulse, high temperature and mental confusion. During the first week a small petechial rash comes out on the trunk first and then the limbs. Each spot is smaller than the measles blotch and the centre is blood-stained, so that the whole body looks dusky, and the patient takes on a characteristic mousy odour. The expression is that of a drunken man. The pupils are contracted and the patient lies in a state of semi-coma. His urine and fæces may be passed under him. At night there is a low muttering delirium and may be restlessness.

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The prostration is intense—no disease makes a greater demand on the strength of the patient. About the fifteenth day the temperature, which has all this time been kept steadily raised, subsides suddenly by crisis.

Management consists in maintaining the strength of the patient through the ordeal. The young, the aged, and the weakly have little chance. The mortality of the starving poor during epidemics of this disease used to be frightful. Sleep, food and stimulation are the main nursing helps, the last of these being steadily increased as the crisis approaches. Early coma, violent delirium, great prostration, all bode ill.

Influenza occurs in epidemics, which affect a large number of individuals simultaneously. The disease is highly infectious, but in what way it is conveyed is not known.

Symptoms.—The disease may assume a great many different forms, according to the part of the body most attacked. The commonest form in which it appears is something like a very severe cold in the head. Its onset is sudden, marked by a rise of temperature and shivering, there is headache with pain at the back of the eyes, and pain in the back and extremities. Sneezing ushers in an acute catarrh of the nose, which gradually passes off in the course of a week, leaving a considerable amount of prostration behind, from which the patient may only slowly recover.

Other forms of the disease are not uncommon, in which gastric and bronchial symptoms predominate. Pneumonia is a complication to be feared, as it is responsible for many fatalities.

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Sometimes symptoms simulating an attack of acute appendicitis are met, and sometimes the catarrh spreads to and causes suppuration in the sinuses of the nose.

Management.—For ordinary cases rest in bed for a few days till the temperature has subsided, and confinement to the house during convalescence, is all that is required. From the aged and feeble the disease is not shaken off so easily, and care is necessary. Even among the strong and healthy severe and crippling complications are met with in those who have neglected the ordinary precautions during the early stages; among the commonest of these are heart and nervous troubles.

Smallpox.—Before the discovery of vaccination, smallpox or variola was an ever-present scourge, greatly dreaded owing to its large mortality and the great disfigurement it caused. Now it is only seen rarely, and in a mild form, but epidemics with all the old features occur where the precautions of vaccination are neglected.

Only those showing well-marked vaccination scars should be allowed in attendance upon the patient, it is safer too even in their case to re-vaccinate them if this has not been done recently. All people with whom the patient has recently been in contact should be vaccinated and if possible isolated.

Symptoms.—The incubation period is twelve to fourteen days. The invasion is sudden, with rigors. vomiting, headache and such intense pain in the lumbar region of the back as to be mistaken sometimes for acute lumbago. On the third day the rash appears in the form of small papules on the

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face, neck and wrists, and spreads rapidly to the rest of the body. The papules are hard like shot under the skin, in three days they are vesicular and contain clear fluid, in six days they are pustular and contain matter, the skin round being œdematous and inflamed. The pocks gradually subside and cab over. With the outbreak of the rash the severity of the symptoms subsides, and the temperature becomes rather lower, it rises again, however, on the rash becoming pustular. The symptoms at this time also become very severe and delirium at night is not uncommon. The mouth becomes sore, and swallowing difficult, as the rash appears on the palate and throat as well as on the skin. The tongue is dry and thickly furred.

If the patient has been vaccinated the disease runs a very mild course, severe symptoms being very rare, especially if they have been vaccinated twice. But in those unprotected by vaccination the more fatal forms of the disease are often seen. In the *confluent form* the papules are so closely set that they run together, and very little if any healthy skin can be seen between them. In the *hæmorrhagic* form the inflammation is so severe that hæmorrhage takes place into the papules. Both these forms are accompanied by a high temperature, delirium and sleeplessness; both forms are very fatal. The urine should be examined daily, as nephritis is liable to occur.

Management.—Attention should be paid to the condition of the mouth, and an antiseptic mouth-wash or gargle frequently used, in bad cases the nurse will have to swab the mouth and keep it moist and keep the nose clear. The temperature can be

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kept under control and sleep promoted by tepid sponging. The eyes need attention, as pustules form under the conjunctiva, while the lids become so œdematous that they cannot be opened and the discharges may be pent up between them; a few drops of castor oil between the lids relieves the irritation. Later on carbolised oil may be smeared over the body or the scabs loosened by actually poulticing them off; if left, the discharge underneath becomes very offensive.

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CHAPTER XX

INFLAMMATION

Definition. — Inflammation is the succession of changes which occur in a living tissue when it is injured, providing that the injury is not severe enough to destroy the tissue at once.

The causes of inflammation are—

1. Mechanical, such as blows, sprains or foreign bodies.
2. Chemicals—strong acids or alkalies.
3. Electricity, either as electric currents or lightning.
4. Burns and scalds.
5. Bacteria.

Changes.—The changes which take place in inflammation are (1) changes in the circulation, and (2) changes in the tissues.

1. *Vascular Changes.*—As the result of the injury the blood-vessels dilate and the part becomes red and hot. Then follow two stages, first there is acceleration of the blood flowing in the vessels, followed soon after by retardation of the flow, this latter goes on till the flow is almost arrested, and the condition is said

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to be one of stasis. During all this time the fluid part of the blood has been escaping from the vessels into the surrounding tissues. This exudation of inflammatory lymph causes the part to become swollen and painful, as the tissues are put upon the stretch. This exudation, if fluid, is also accompanied by a migration from the blood-vessels of the blood-cells, chiefly the white ones, which enter the tissues in large quantities.

2. *Changes in the Tissue* vary with the nature of the irritant. In severe cases the tissue may simply die after a few hours, together with the cells which have migrated into it, this is termed coagulation necrosis. In slight cases overgrowth of the tissues takes place. In moderate cases a small amount of necrosis may take place where the irritation is most severe, while round about, where there is less irritation, overgrowth takes place.

Clinical Features.—The inflammatory changes are shown clinically by the features, the explanation of which have already been given. They are: (1) Redness and heat due to the hyperæmia, (2) Swelling from the exudation and pain due to the stretching and tension of the tissues. (3) The pain is often of a throbbing nature, especially when pus is present, as the vessels are so dilated that the pulse reaches the smallest vessels, and every heart-beat adds slightly to the tension. In addition to these signs there is (4) impairment of function in the

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part, for an inflamed part cannot perform its duties in a proper manner. You cannot walk comfortably with an inflamed foot or see clearly with an inflamed eye. Besides these local signs there are often general symptoms, such as a headache and a general feeling of discomfort, loss of appetite, a slight rise of temperature (99° to 101° F.). This is known as aseptic traumatic fever and usually passes off in twenty-four hours. It is due to absorption of the inflamed lymph. If sepsis develops a septic temperature ensues.

These are the changes of inflammation; if traced further certain things may happen.

1. *Resolution* or a gradual return to the normal. The condition of stasis ends by the circulation being gradually restarted in the blood-vessels. The exudation is slowly drained away by the blood or lymph stream. Of the migrated white blood-cells, some return to the blood stream, while others die and disappear. The red blood-cells disintegrate, and their colouring matter forms the pigment seen in bruises and where tissues have been inflamed for a long time. Overgrowth round about replaces tissue cells which may have been actually destroyed.
2. *Inflammation becomes Chronic.*—Here the cause continues to act and keeps up the tissue changes. The vessels remain dilated, the lymph is poured out and the cells are constantly migrating into the tissues, which become thickened by overgrowth of the fibrous tissue. The part is constantly

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swollen, hot and tender, and its function is impaired.

3. *Suppuration.*—This implies the presence of pus-forming bacteria. These organisms by their growth and by their toxins actually digest and liquefy the tissues, at the same time they destroy large numbers of the blood-cells which migrate to the part. In this way an abscess is formed; it consists of a cavity containing liquefied tissue and inflammatory lymph in which there are numbers of dead and dying blood-cells, both red and white, fragments of disintegrating tissue, and lastly the bacteria themselves. This liquid is termed pus, and when this forms suppuration is said to have occurred. The action of the bacteria will go on until the white blood-cells migrate to the part in sufficient quantities to destroy the organisms, or until the abscess bursts or is opened and discharges the fluid, together with the majority of the bacteria. The signs of an abscess are the signs of an intense inflammation, viz. redness, heat, swelling, pain, impairment of function to which must be added fluctuation, which is the elastic feeling given to the fingers by the presence of fluid in the part.
4. *Ulceration* is the suppuration on a free surface, either skin, mucous membrane or on any free surface in the body.
5. *Cellulitis* or 6. *Gangrene* } may take place. (See *Infected Wounds.*)

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Treatment of Inflammation.—The object of all treatment is to promote a rapid return to the normal, and may be indicated as follows—

1. *Remove the Cause.*—This prevents further irritation, thus a foreign body should be removed from the eye, a blister should be shielded from further rubbing of the boot, acids should be rapidly washed from the skin, and bacteria killed by antiseptics.
2. *Rest to the Inflamed Part.*—Impairment of function indicates nature's attempt to give the part rest. In the upper limb the arm must be bound to the body or fixed, either in a splint or a sling. If the lower limb is at fault, the patient should be confined to bed or to the couch, and the limb fixed either by splints or by sand-bags placed on each side.
3. *Reduce the Congestion.*—This eases the pain by lessening the engorgement of the inflamed part, and is brought about in many ways.

   Elevate the Part.—If in the hand, the arm should be bent at the elbow and the sling arranged to keep the hand up near the throat. If in the lower limb, the foot can be raised on a pillow to allow an easy return of the blood in the veins.

   Local blood-letting, either by leeches, punctures, and wet or dry cupping, are sometimes most useful and may give immediate relief. In rapidly spreading septic inflammation, free incisions by the surgeon may be needed.

   When applying a *leech* it is necessary to

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make it take hold at the right place. This may be done by pricking the part and putting the animal to the drop of blood or by applying a drop of milk to the part. Leeches will abstract from two to four drams of blood and then usually drop off, they can, however, be made to let go any time by the application of a little salt. If it is wished to continue the bleeding a hot fomentation can be applied over the part. To stop the bleeding, the part should be washed, dried and painted with collodion or slight pressure applied. Leeches should not be applied over large veins or in situations where pressure cannot subsequently be used, for instance to the eyelids or scrotum.

Cold is of the greatest service in inflammation by constricting the vessels and limiting the exudation. It is used in the early stage only, and never when suppuration has occurred, as it lowers the vitality of the tissues and therefore may do more harm than good. It should not be applied to the very old, very young or very feeble, as it may cause necrosis of the skin from frost-bite. It is usually applied as an ice-bag. An ice-bag can be improvised by placing chopped-up ice in a square of mackintosh, lifting up the four corners and tying a piece of string tightly round just below the edges of the square; unless the string is below the edges the water will escape. Another method of applying cold is to lay the limb in a mackintosh, cover the part with lint

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and allow ice-cold lotion to drip on to the lint. The drip can be regulated by hanging a piece of lint over the side of the vessel, the part on the outside hanging down below the level of the fluid in the vessel, the fluid will then flow slowly from the vessel along the lint to drip off the end. The mackintosh under the limb is arranged to catch the water and prevent the bed becoming wet, a similar drip arrangement can be made to drain the water from the mackintosh into a receptable at the bedside.

Another method of applying cold, which is not much used, is to allow cold water to circulate through a coil of metal tubes placed upon the inflamed part. *Heat*, especially moist heat, acts in the opposite way to cold, relaxing the vessels by increasing the vascularity of the tissues round about, it promotes the removal of the inflammatory products by the blood-stream and the lymph. It is therefore most useful when inflammation is at its height. If bacteria are present moist heat hastens the formation of the abscess and brings it more rapidly to the surface. Moist heat is usually applied in the form of poultices and fomentations (see p. 401). The former, though not much used in surgery, are still in common use among the laity, they should not be used where the skin surface is broken. Fomentations are usually medicated with some antiseptics. Carbolic fomentations should never be applied to the hands or feet or to

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children. Warmth may be applied in the form of a continuous bath, the limb being laid in a tin trough, one end of which is sloping and hollow to receive it comfortably. The trough should hold about six to eight pints of fluid, to which some mild antiseptic has been added, the temperature of which is kept up by adding hot water from time to time; a piece of mackintosh, over which is placed flannel or wool, is laid over the top of the bath to help keep in the heat. This bath is chiefly used in rapidly spreading forms of cellulitis where free incisions have been made to encourage the escape of the bacteria-infected exudation. It is often useful in helping to cleanse large surface wounds with sloughs, such as crushes or burns, where the skin is obviously going to die but cannot as yet be removed.

4. *Bier's Passive Congestion* is a method by which septic inflammation can sometimes be arrested in the early stages by so congesting the part that the exudation of lymph and migration of white blood corpuscles is sufficient to overcome the invading bacteria before they have injured the tissue to any great extent. In later stages of septic infection it acts much in the same way as moist heat, hurrying the action of the bacteria and bringing the abscess to the surface.

   To apply the method to a portion of a limb, an elastic bandage is applied above the area to be congested. This band must be tight enough to embarrass the return of

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blood through the veins without interfering with the arterial supply. As a consequence of this more blood goes into the part than can leave it, the limb beyond the bandage fills with venous blood, it swells and assumes a bluish look. The band should not be tight enough to cause pain. Experience alone will teach the right tightness to apply it. If the part of the limb to be congested is the elbow or the knee, it is much better to apply a supporting bandage of linen which does not stretch up the limb to below the joint, than the constricting band above. By this means the congestion and swelling are limited to the part desired.

To congest the surface of the body the ordinary dry cupping may be performed or Bier's cups used. They are cupping glasses to which a stiff ball of indiarubber is attached; the ball is pinched to drive out the air as the cap is applied, on relaxing the grasp the skin surface is drawn up into the cup, and becomes intensely congested. The cups are made of various shapes and sizes to fit the surface of the different parts of the body; some are arranged so that the air can be exhausted by means of an air-pump.

General Treatment. — The strength of the patient must be maintained by nourishing and easily digested food, the stomach does not act well as long as the temperature is above the normal. The food is therefore confined to milk, soups and simple

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preparations of meat. Elimination of the poison is promoted by giving plenty of fluid to drink. This is easily done as the patient is usually thirsty, and to the drink can be added drugs which make the kidneys excrete freely, so washing out the effects of the poison. For the same reason medicine is given to promote the action of the bowels. Stimulants are not necessary, but in old or feeble people are very beneficial.

The Treatment of Chronic Inflammation.—If the acute inflammation does not clear up under treatment it passes into the chronic stage, this is often due to the fact that the cause cannot be removed at once, and great care is needed to seek and remove this as far as can be done. Other methods of treatment can also be tried.

Counter-Irritation.—The principle of this is to create a mild inflammation in the superficial parts and so diminish the amount of blood in the deeper parts. This may be carried out by various means.

1. *Liniments* such as liniment of turpentine rubbed into the skin will cause reddening of the skin from an increased flow of blood, the rubbing also accelerates the blood and lymph flow in the part. Some of the strong liniments, such as iodine or croton oil, cause actual blistering and should not be applied to delicate skins. They should be painted on and not rubbed in.
2. *Blisters* are powerful counter-irritants, the cuticle or superficial part of the skin being raised from the part beneath by the rapid effusion of inflammatory lymph. They

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are best produced by painting a small area with blistering fluid (liquor epispasticus); care must be taken that the fluid does not run beyond the prescribed area, to prevent this a ring of olive oil may be painted on first. The other method is to use a blistering plaster (emplastrum cantharides) which is a thick ointment smeared on stiff paper or leather and is applied to the skin and fixed with a bandage. When the blister rises this drags on the skin and hairs and causes more pain than does the blistering fluid. Blisters take three to six hours to form, the plaster takes rather longer, during which time the skin should be covered to protect it. If warmth is applied at the same time the process is assisted. When the blister has risen it should be snipped at the most dependent part with a pair of clean scissors, this eases any pain by reducing the tension. It is then covered with a piece of lint smeared with boracic ointment.

3. *Ointment* and pressure are frequently combined in the form of Scott's dressing and plaster. Scott's dressing contains camphor, olive oil, mercury and yellow wax spread on lint which is cut into strips. The strips are then applied to the part, usually a joint, and over them strips of lead plaster are placed, each succeeding strip of plaster overlapping the preceding one. To make the plaster stick it is previously heated, over all a bandage is applied and the dressing can be left on for a week or longer.

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CHAPTER XXI

SEPSIS, ANTISEPSIS AND ASEPSIS

Sepsis is the process brought about in the tissues by germs or micro-organisms. Micro-organisms are found everywhere. They are quite invisible to the naked eye; so small are they that they can only be seen under the microscope when stained with bright colours. There are many varieties of micro-organisms, probably the varieties are as numerous as the varieties of the larger animals with which we are familiar; but as among the latter only a few are dangerous to life, so among the micro-organisms only a few are able to attack us.

For convenience they can be divided into two great classes according to their shape, namely the cocci and the bacilli. A coccus is a more or less rounded object, while a bacillus is elongated and said to be rod-shaped. In each of these two great classes there are many large families, each having many varieties, but the following list will be sufficient to illustrate their life and mode of action.

Cocci.—As these are all rounded objects they all look alike individually, but when growing actively they can be divided up like plants, by their colours and the way in which they grow.

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Staphylococci. — These grow in clusters like bunches of grapes, the different varieties showing different colours.

Streptococci.—These are said to grow in chains, but look more like the beads of a necklace than the links of a chain.

Diplococci.—These appear double as they grow in couples. This family is large and includes many organisms of special diseases such as the pneumococcus which causes pneumonia and the meningococcus which causes a certain form of meningitis.

Bacilli.

1. The diphtheria bacillus which causes diphtheria.
2. The tubercle bacilli which causes tuberculosis.
3. The typhoid bacilli which causes typhoid or enteric fever.
4. The anthrax bacilli which causes anthrax.
5. The Bacillus Coli communis or the common bacillus of the colon which lives in the intestine and causes peritonitis if the intestine leaks into the peritoneal cavity.

Distribution.—Bacilli are unevenly distributed, there are none in the pure air of the mountain heights or in mid-ocean, they are present in vast numbers in centres of population and inhabited houses. They are not given off from still water which contains them. They are able to float in the air on particles of dust, so that still air where the dust has settled is sterile, disturbing the dust sends thousands into the air. The human skin on which

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dirt settles teems with organisms. Most of these can be removed by washing; some, however, live in the depths of the skin. They are also present throughout the alimentary canal.

Method of Action.—In ordinary health the growth of organisms is prevented in the body by a natural resistance, but if that resistance is lowered from any cause the bacilli may grow and multiply in the body, and bring about certain reactions.

Bacilli act by means of toxins which they produce. Sometimes, as in diphtheria, the bacilli remain locally, in this instance in the throat, and the toxins are absorbed and produce serious effects. In tubercle the bacillus itself must enter the tissues before it produces its effect. As we have already said the majority of the organisms are harmless, and in order that disease may be produced by organisms certain things are necessary.

1. The organisms must be pathogenic, that is, capable of producing disease, and not one of the harmless varieties.
2. The body must be susceptible to the disease.
3. Toxins must be produced.
4. The toxins must get into the body.

As a further explanation we must point out that diphtheria bacilli are often found in the throats of nurses in charge of such cases, and yet they have not got diphtheria. Here the nurse may not be susceptible, or the bacilli may not be producing any toxins or the toxins may not become absorbed. Toxins swallowed by the mouth have very little action.

After the bacilli gain a lodging in the body

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nothing happens until a period of incubation elapses, during which time we suppose that they fight and overcome the germicidal action of the tissues, and then begin to multiply and manufacture their toxins in large amounts.

Cleanliness.—In order to rid ourselves of the fear of sepsis we have two great methods. First we try and lessen the number of organisms present by cleanliness, secondly we have antiseptics, by which we endeavour to kill all those we have not got rid of by the first method. Cleanliness used in this sense in a modern hospital is largely an avoidance of dust and anything which will harbour it. This can best be exemplified in describing a ward.

A ward is a large room where a number of cases are tended. It should be large and lofty enough to allow about two thousand cubic feet of air space to each patient. There must be ample window space arranged so as to ventilate the upper, as well as the lower part, of the room and admit plenty of sunlight. Sunlight is a powerful preventive of the growth of organisms.

The window-ledges should be shallow and rounded off into the walls. The walls should be perfectly plain with no hangings about the windows, as curtains are great harbourers of dust. The walls are distempered or covered with some washable paint so that they can easily be sprayed down. The ceiling is white-washed, the floor is polished wood, well laid so that the cracks between the boarding are small. These cracks are filled with wax or other material and the floor kept polished. Where the walls and the floor join the angle is filled in with plaster so that the wall

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becomes gradually rounded into the floor, thus doing away with any crevice where dirt may lodge. There is a table with a polished top, but no table-cloth. Basins are fixed to the side wall with hot and cold taps, where the hands can be washed. Close to the basins is a small steriliser for boiling instruments. A white enamelled stand mounted on wheels so that it can be moved about the ward is fitted with lotions, dressings, bandages, etc. There is also a small white enamelled receptacle on wheels, fitted with a hinged lid which receives the soiled dressings as they are removed from the patient. There is a small stationary table with chairs where the sister and nurses can do the writing of diet cards, charts, etc. The beds, which are arranged down the sides of the ward, are of plain iron of about two and a half feet wide; at the head of each is a small polished wood locker which also acts as a table, in this clean nursing conveniences are placed, which are removed at once on use, emptied, cleaned and returned. Out of the ward open the lavatories, bath-rooms and a small ward kitchen. There are no hangings, no cupboards or shelves in the ward itself. All soiled dressings, bandages and dirty linen are at once removed. Screens are fitted with coverings which can easily be removed and washed. There is no place where dust can be harboured. With a minimum of trouble the floor can be washed and polished, and if necessary, the walls sponged down.

By these means we try to reduce as far as possible the number of organisms in the wards, passages and rooms of a hospital.

Antiseptics are the means by which we deal with

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the organisms which, in spite of our cleanliness, we know to be present. The methods at our disposal are (1) heat, (2) chemicals.

Heat is the best and most powerful antiseptic we have. It is best employed moist, as boiling water or steam. Boiling for five minutes will kill all organisms harmful to the human body, and all articles used which are capable of being boiled without being harmed should be so treated. Instruments should all be boiled before use, a little soda being added to the water to prevent tarnishing. Knives and other sharp instruments, however, become blunt on boiling and are therefore usually treated with chemicals. In hospitals all towels, overalls, masks, swabs, etc., are packed in drums and subjected to steam at a high temperature and sufficient pressure to ensure that the steam penetrates. After a time the steam is turned off and a vacuum formed so that the materials are completely dried. The drums are then removed, shut tightly and can be kept all ready for use.

Chemicals are used for the hands of the surgeon, the skin and wounds of the patient, and for many instruments which will not stand boiling. Chemical antiseptics are nearly all poisonous, so great care must be observed in their use. Many people, especially children, have been poisoned accidentally by swallowing these substances, which have been carelessly left lying about.

Carbolic Acid or Phenol is a powerful antiseptic which is sometimes applied undiluted by the surgeon, but should never be so used by the nurse. It is sometimes used diluted to 1 in 20, but even this is too strong for delicate skins, 1 in 40 or even 1 in 60

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being the usual strength. It should never be used for children, as it is readily absorbed. It should not be used as a fomentation to the hands or feet, as it may cause gangrene of the fingers and toes if left in contact with them too long.

Corrosive Sublimate (perchloride of mercury), is used in strengths of 1 in 1000, 1 in 2000, 1 in 3000 or 1 in 4000. These solutions are less penetrating than carbolic, but the stronger solutions if applied as fomentation for long may act as a direct irritant to the skin and cause pustules to form. Instruments should not be placed in corrosive as they become corroded at once, hence the name. The drug is white, but is usually sold in "soloid" form coloured blue, one "soloid" being sufficient if added to a pint of water to produce a 1 in 1000 solution. It is intensely poisonous, and if the "soloids" are left about children may swallow them, thinking they are sweets.

Biniodide of Mercury is, like the last, very poisonous, and is sold in "soloids" coloured pink. It is used in the same solutions are perchloride; it tarnishes instruments, but not so rapidly as perchloride.

Boric or Boracic Acid is a weak and non-irritating antiseptic, usually used in a strength of 1 in 20 or 1 in 40. It is often used in fomentations applied to inflamed parts.

Methylated Spirit is a cheap form of alcohol and a powerful antiseptic, especially if one-third or one-half its bulk of water is added. Biniodide of mercury is often used in conjunction with spirit, a very powerful solution being 1 in 500. It should be remembered that all forms of spirits are antiseptics, and a clean handkerchief dipped in brandy

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or whisky may safely be applied to a wound as a dressing when other antiseptics are not to hand.

Lysol is a coal-tar product and is used in a 2 per cent. solution; it is, however, opaque and renders things slippery; instruments cannot be seen when lying in it. Lysol is an excellent disinfectant for soiled linen and clothing, which often becomes stained if soaked in perchloride or biniodide.

Formalin is a powerful antiseptic, but not often used. A 1 per cent. solution is strong enough to irritate the skin; its fumes, too, irritate the eyes and cause them to water.

Iodine in the form of tincture, 2 per cent., is becoming more and more used as a disinfectant of the skin. It penetrates and acts better on dry skin, it should therefore be applied some time after the skin has been washed and dried or may be painted on even without washing, in emergencies. It stains starched linen blue, but the stains can be removed by a weak solution of carbolic acid.

Glycerine is a good antiseptic and can be used pure in an emergency.

Permanganate of Potash, Sanitas and hydrogen peroxide all act as oxidising agents and are useful in cleansing septic cavities. Of these the last-named is the best. Permanganate of potash is often used to clean utensils and to flush drains.

Iodoform is of very doubtful value, and will even harbour septic germs unless sterilised. It only becomes mildly antiseptic if decomposed in septic wounds, where other remedies would be better used. When used as an emulsion with glycerine the latter substance accounts for any good effect the mixture has. It is very expensive and has a most unpleasant odour.

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CHAPTER XXII

WOUNDS AND COMPLICATIONS OF WOUNDS

A wound is a solution of continuity of the tissues in which the skin participates. Wounds may be caused in a variety of ways and present endless variety of shape, position and size. They can be divided into the following main classes—

1. *Incised* wounds are made by sharp cutting instruments, the edges gape, bleeding is, as a rule, free, healing takes place rapidly if the wound is kept clean, as the edges are not torn or bruised.
2. *Lacerated or Contused* wounds are made with blunt instruments, blows and explosions; the edges are irregular, ragged, torn and bruised, and for this reason they do not heal readily. If superficial they do not bleed so freely.
3. *Stab or Punctured* wounds have a greater depth than the hole in the skin indicates. They may be caused by a sharp instrument, such as a knife or bayonet, or by a blunt one, such as a bullet. They are extremely dangerous as injury may be done to the internal organs, the heart, lungs, liver or great blood-vessels. They are liable to bleed internally. Foreign

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bodies, like fragments of clothing or wadding of cartridges, are apt to be carried into the depths of the wound and sepsis is, therefore, very common.

4. *Poisoned* wounds include bites of insects, snakes, dogs and pricks with instruments on which organisms are present, such as a prick with a needle during a post-mortem examination of a septic case. Though small, these wounds are often fatal.

A much simpler classification from the nursing point of view is: (1) clean wounds; (2) wounds likely to become septic; (3) wounds which are septic already.

Methods of Healing.—All wounds which heal do so in the same way, but there are apparent differences, which cause them to be classed as Healing by First Intention and Healing by Second Intention or Granulation.

Healing by First Intention.—A wound is said to heal by first intention when it remains aseptic, and the tissue then has no organisms to fight and so all its powers are directed to healing rapidly. In a clean wound of this nature when the bleeding has been stayed and the edges brought together by stitches or dressings, the wounded surfaces soon become stuck together by plastic lymph. The process already described as inflammation begins to take place. The part becomes more vascular, the cells from the blood congregate in the neighbourhood and the cells of the tissue begin to proliferate. We have said that in an incised wound the tissues are not injured, this is true only in a sense, for all the tissue

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cells which have been actually in contact with the knife are injured, and these have to be absorbed and removed by the inflammatory round cells. New loops of blood-vessels form from the blood-vessels near and permeate through the masses of round cells which occupy the site of the wound. These loops grow in from each side until they meet and join across the wound. This tissue is now known as granulation tissue, and if the lips of the wound were forcibly separated, it would bleed and be seen as a soft, red mass. Along these blood-vessels connective tissue cells grow and gradually elongate across the wound to form fibrous tissue binding the two sides together. This fibrous tissue then begins to shrink, drawing the edges of the wound firmly together. As it shrinks it obliterates the blood-vessels until few are left and a white fibrous scar is the result. The deeper layer of the skin never reforms, its place being taken by the scar tissue, but the superficial layer joins across the wound and the healing is complete.

Healing by Second Intention or Granulation.—This takes place when the wound is septic or where the edges cannot be brought together, as in ragged contused wounds or where the edges are separated by extravasation of fluids.

For purposes of description we will suppose it is a wound where an area of skin has been destroyed and the edges are not brought together. Lymph is thrown out, but this escapes as a discharge; in aseptic wounds it is clear plastic lymph, in septic cases it is pus. In this case there is a great deal of injured tissue which must be absorbed and removed by the inflammatory cells. As this goes on

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the wound may appear a little larger than it was at first, and the inflammatory reaction will be greater than in the last case.

Granulation tissue gradually forms all over the surface, that is, loops of capillary blood-vessels in masses of round cells. This tissue goes on forming layer by layer. In the deeper layers the connective tissue cells are formed; these by their contraction gradually make the area of the wound smaller. The superficial layers gradually fill up the deficiency caused by the wound, hence the term "*the wound granulates up from the bottom.*" As the granulations are very vascular and continually exuding lymph there will be a continuous discharge from the surface of the wound into the dressings. Meanwhile the epithelium from the edges grows in over the granulations until it meets in the middle and covers over the whole granulating surface. The fibrous tissue continues to be laid down beneath and as it contracts the scar which at first was pink gradually becomes whiter. The larger the wound is, the longer it takes to heal, and the longer it takes to heal the more fibrous tissue is laid down, and the more fibrous tissue is laid down the more contraction takes place, so that when large areas of skin have been destroyed, as in burns, considerable deformity may be seen.

In some cases the fibrous tissue binds the granulating surface to the bones beneath and makes it very difficult for the epithelium to grow in, hence the chronic ulcers so often seen over the tibiæ. Sometimes actual skin grafting has to be performed before healing will take place.

Healing under a Scab may take place in small

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wounds and is sometimes referred to as a third method of healing. The scab is formed by the drying of the plastic lymph which exudes from the wounded surface. This is nature's method of protecting the raw surface. Granulation tissue forms below the scab, and the epithelium grows in, the scab then falls off, leaving a healed surface.

Scars, if small, may disappear and the slight cuts about one's fingers usually leave no mark. But deep cuts and wounds in which much scar tissue is formed, as in those which have healed by granulation tissue, remain throughout life. Over areas where there is considerable amount of fat, scars may stretch and become larger, so that what originally was a linear scar may become oval in shape. Large superficial scars tend to contract. Sometimes if a scar is bound down to a small superficial nerve it remains very tender and is called a painful scar and the nerve may have to be divided later. Sometimes an overgrowth of scar tissue takes place and what is known as a keloid develops. As the deeper layer of the skin takes no part in scar formation the scar is devoid of hair and sweat glands, as these are situated in the deeper parts of the integument.

Treatment.—In the treatment of wounds which are received in everyday life the great object is to render and keep them aseptic, and much of this devolves upon the nurse. She often has to deal with the wound before any medical man sees it, and later on the dressings are part of her duties. Aseptic wounds such as are inflicted during surgical operations do not concern us here where we deal with a wound as the result of an accident.

First Aid Principles.—As the wound has been

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received in septic surroundings and been inflicted by an unsterilised instrument it must be presumed to be septic. If the wound is severe a doctor should be sent for, especially is this the case if the bleeding is free. We will presume the wound is not bleeding excessively.

The first thing to do is to apply pressure to stop any bleeding which is taking place. Used pocket-handkerchiefs or any dirty linen should not be used if this can be avoided. A newly washed and unused handkerchief can be applied and held firmly over the surface while more elaborate preparations are made.

An antiseptic solution should be obtained as quickly as possible. Those easiest to obtain in a hurry are methylated spirit, brandy or whisky, which are about the same strength, Condy's Fluid, and sometimes turpentine. If a chemist is near a messenger can be dispatched for a bottle of 1 in 20 carbolic or some "soloids" of biniodide of mercury.

After washing and disinfecting her hands, the nurse removes the temporary dressing and uses the antiseptic lotion to clean the wound and wash away any dirt, grit or blood-clot. It is better to use the lotion as hot as the hand can bear, as this will stop any oozing that may still be present. When the wound is thoroughly clean a dressing which has been wrung out in a weak antiseptic can be applied and kept in place with plaster or a bandage, which will serve to bring the edges together. For small cuts this may be quite sufficient, while larger cuts can in this way be cleaned and protected till such time as a surgeon can be procured, who will put in the necessary stitches.

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In the event of none of these materials being to hand, the kettle should be put on to boil and two or three clean handkerchiefs placed in the water. After boiling for a few minutes the kettle should be placed in cold water till its contents are cool enough to be used. This sterile water and the sterile handkerchiefs can safely be used for the wound. In a hospital, with medical aid at hand, gauze, lint, antiseptics and instruments can be had for the asking and no difficulty can arise, but to keep one's head and to know what to use in a hurry where choice of materials is limited, and to assume command over those who are naturally excited and upset by the accident, is a task which taxes all the powers of a good nurse. Experience alone will give her confidence.

The Dressing of Wounds.—Before the dressing is to be removed everything likely to be needed will be got ready. The instruments, scissors, forceps, syringe, etc., laid in an antiseptic, a receptacle for the dirty dressings and a dish to receive lotion should be got ready. The new dressings and bandages all prepared.

The hands are washed and the bandage unwound or cut off. The hands are then rinsed in antiseptics again, and the dressings removed gently with forceps. Care must be taken where stitches have been used, as the ends are liable to become entangled in the gauze. Where the dressings have stuck they must be soaked off. If the wound is stitched up the dried discharge and blood round about is washed away; if the stitches are tearing out, or the skin round them red, a certain number can be cut or loosened, or the matter reported to the doctor.

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In a lacerated open wound, the lotion is allowed to run into the depths of the wound from a dripping swab or a syringe used. The skin round is cleaned and the surface of the wound examined to see if sloughs are coming away. Later on a mental note is made as to size, how the epithelium is growing in from the edges, and the condition of the granulations at the bottom. There are no nerves in the granulations, which have no sensation on being touched, although the wound looks sore, but they bleed very easily and should be treated with great gentleness.

The new dressings are then applied, either wet or dry as preferred to a closed wound, always wet on an open wound, a piece of waterproof being put on over it so as to keep in the moisture; this prevents the dressing sticking to the wound and causing pain at the next dressing. Some cotton wadding can then be applied to distribute the pressure of the bandage.

Complications of Wounds.—These are: (1) hæmorrhage; (2) shock; (3) fever; (4) cellulitis; (5) erysipelas; (6) gangrene; (7) tetanus.

1. *Hæmorrhage* is a complication requiring instant treatment, but is dealt with elsewhere.

2. *Shock* is the name given to the condition of collapse from which a person suffers as the result of a shock. They are, therefore, said to be shocked or suffering from shock. No difficulty will be met with if your bear in mind that a severe shock of any sort will produce a condition of collapse. The symptoms and treatment are given on p. 354.

3. Aseptic Traumatic Fever.—This is the slight rise of temperature, increased pulse and respiration

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rates, headache, loss of appetite, and feeling of general malaise which are experienced after an accident. The condition lasts for twenty-four to forty-eight hours and is well seen after a simple fracture. No special treatment is demanded, the patient should be kept quiet, preferably in bed, on a light diet, and it is well to give an aperient.

4. **Cellulitis** is an acute spreading inflammation of the cellular or loose tissues, either subcutaneous or deep, due to infection by micro-organisms, usually streptococci. After an incubation period of a few hours, general symptoms of sepsis commence to show themselves, often starting with vomiting and a rigor. Local redness appears at the wound and fades gradually into the natural colour of the skin, there is a brawny swelling of the part, which later becomes soft and boggy. The part is hot, œdematous and painful, and often inflamed lymphatics can be seen, as red lines, passing up to the nearest lymph glands, which will be found enlarged and tender. Cellulitis must always be regarded with anxiety. Sometimes a localised abscess forms, but more often diffuse suppuration takes place throughout the cellular tissue. The skin gives way at various places and the pus is discharged. If the infection is severe and the tissue loose, as in the eyelids or scrotum, gangrene may occur, and extensive sloughs of fibrous tissues may come away before healing will take place.

Management.—This is the same as for acute inflammation generally. In this case, however, free drainage must be provided to try and stop the spread of the infection. Multiple incisions have sometimes to be made to give exit to the pus and

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sloughs. Antiseptic fomentations are applied or the limb placed in a continuous antiseptic bath.

During the slow healing the general health must be maintained and care taken that the joints are moved at each dressing, so that adhesions are not allowed to form. In some cases where the infection is very virulent amputation of the limb may be needed.

5. **Erysipelas** is an infective form of cellulitis met with after infected wounds, especially those about the head and face. The inflamed area is bright red and swollen so that its raised edge contrasts strongly with the normal colour of the skin. The disease is infectious and one attack seems to render the patient more susceptible to subsequent attacks. The symptoms and course are similar to those described under ordinary cellulitis.

The Management also is similar, the pain of the inflamed skin is best relieved by smearing over it ordinary lanoline, a mask smeared with this may be fitted over the face. The eyelids give special trouble and often have to be incised. If it affects the scalp it may spread along underneath it and free incisions are needed to let out the pus. There is danger of the organisms finding their way through the bone to the interior of the skull.

6. **Gangrene,** *Mortification or Death* of the part may take place in a small area from pressure, hence the formation of bed-sores, or it may be very extensive as when a whole limb dies after a severe crush or similar injury. Gangrene may be brought about by acute inflammation and by intense cold as in frost-bite and also by heat as in burning.

The local signs of gangrene are as follow—

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1. Loss of pulsation in the vessels supplying the part.
2. Loss of heat, the part becomes cold owing to the lack of circulation.
3. Loss of sensation, due to the death of the nerves.
4. Loss of function.
5. Alteration in colour.

In addition to these there are general symptoms which are dealt with further on.

There are two forms of gangrene, the moist and the dry or senile form.

Moist Gangrene occurs as the result of acute and violent inflammation or after severe injuries interfering with the blood supply of the limb. The limb becomes swollen, livid and mottled in colour, and even greenish black in parts. Blisters form under the cuticle, which is easily rubbed off. The limb has a very disagreeable odour. If the gangrene ceases to spread a reaction occurs in the living tissue adjoining the dead portion. The dead portion acts as a powerful irritant so that the living tissue is inflamed and a red line of demarcation forms at the junction of the two parts. The dead portion is gradually thrown off or is removed by the surgeon. Severe constitutional symptoms accompany moist gangrene as the process is nearly always septic. The temperature is high and irregular, the pulse rapid and weak, the sweating is profuse, there is little desire for food, while at night the pain in the living portion prevents sleep. The wasting is rapid, at night there is unconsciousness and delirium and the patient often dies from exhaustion.

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Dry or Senile Gangrene is the result of the gradual obliteration of the arteries by the thickening of their walls which occurs in old people. It therefore occurs in parts furthest from the heart where the circulation is naturally not very brisk, such as the toes, fingers and ears. The toe becomes numb and cold, and gradually turns black, hard and shrivelled. The process is very painful, but if sepsis is excluded there are very few constitutional symptoms.

Management.—Preventive Measures.—Where gangrene is suspected the limb should be carefully washed with soap and hot water, special attention being paid to the spaces between the toes, an antiseptic lotion applied and carefully dried. The part should then be dusted well with boracic powder, and powdered wool placed between the toes and the whole limb swathed in warm wool. The limb is then raised to help the circulation and hot bottles arranged to keep it nicely warm.

With Dry Gangrene this same treatment is continued, the greatest care being taken to exclude the presence of putrefactive organisms till the shrivelled part drops off.

In Moist Gangrene the part is nearly always septic and the treatment is often directed to staying the spread of the inflammation; antiseptic lotions or fomentations are applied, often with some deodorant to control the horrible fœtor which sometimes arises.

In both forms it is highly necessary to maintain the strength of the patient by seeing that plenty of nourishment is taken. Stimulants are of great use in the enfeebled and exhausted, while opiates are invaluable to control the pain and induce sleep.

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7. **Tetanus** is a disease caused by a drum-shaped bacillus gaining access to a wound. The toxin generated by the bacillus acts on the central nervous system and causes the symptoms characteristic of the disease.

The bacillus lives in the surroundings of stables and is found in ground that is highly manured, such as gardens, roads, etc. The disease is therefore likely to follow any wound in which earth has been ground into the tissues. It is prevalent among soldiers where the wounded have been left lying upon the ground unattended.

The *symptoms* only appear after definite incubation periods, and the longer these periods the more hopeful is the outlook: very roughly, if the incubation period is seven days or less, it is fatal; if the incubation period is fourteen days about fifty per cent. live; if twenty-one days all recover.

The earliest symptom is stiffness of the muscles, of the jaws and the back of the neck, with difficulty in swallowing. This gets worse till it is found that all the muscles are contracted and the body and limbs are perfectly rigid. The position during this tonic rigidity is only altered by severe spasms of the muscles in which the body may become bent backwards (opisthotonus) so that the person may rest on the back of his head and his heels.

The slightest stimulus, such as a touch, a bright light, a door banging, suffices to bring on the spasms and often they come on for no apparent reason. Death takes place from exhaustion due to spasms and want of sleep and food.

Treatment consists in prevention, every wound should be rendered as nearly aseptic as possible,

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and special care taken in those in which earth has been ground into the tissues. Once the disease is established the wound may be excised or amputation performed so as to prevent the absorption of more toxins. Where this is not possible the wound should be scrubbed with antiseptics and fomentations of hydrogen peroxide applied as the bacillus does not flourish in the presence of oxygen.

Of remedies the injection of anti-tetanic serum should be tried and large doses of sedatives, such as chloral and bromide, given at short intervals, with morphia and even chloroform for the more severe spasms. At the same time the strength of the patient should be maintained by highly nutritive food or by enemata.

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CHAPTER XXIII

OPERATION

Preparation of the Patient.—The proper preparation of a patient for an operation requires some twelve hours, in some cases longer. In emergencies and accidents, however, this cannot be secured. During the previous day a very light diet should be taken so that there will be little residue in the intestine. The evening before the operation the patient should take a hot bath and if necessary the site of the operation should be shaved of hair and special attention given to it. He then puts on clean nightclothes and goes to bed. An aperient is given so that the bowels should act early next morning. This is especially important in abdominal cases, as flatulence and discomfort is very likely to occur after the operation if the intestine is loaded. Early next morning he is given an enema of warm water with a little turpentine or soap in it, to clear out the lower bowel. In children simple warm water should be given as turpentine is too irritating, and soap is liable to cause a rash which may be mistaken for some infectious disease thirty-six hours later. Nowadays it is recognised that there is no need to apply the hot antiseptic fomentations which were in vogue till quite recently, the skin is sterilised on the table

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by painting it with iodine. Sometimes it is also painted the night before, but the iodine burns considerably and in some skins causes such irritation that sleep is prevented.

The Operating Theatre.—It is unnecessary to describe the operating theatre in a modern hospital to any one who works in such an institution, and to those in the Territorial Service or Red Cross who have not this advantage a visit to the nearest hospital under the guidance of a medical officer will be far more beneficial than a mere description. Such a visit should be insisted upon and the carrying out of an actual operation should if possible be witnessed.

It is desirable, however, that the chief requisites for an operation in private should be enumerated and best ways to attain them.

Operations in Private.—*The Room* should be situated if possible near, and on the same landing as, the bedroom in which the patient is to be nursed later; it is a great disadvantage if the patient has to be conveyed up or down stairs in an unconscious condition. Sometimes it is convenient to have the bed made up in the same room as that in which the operation is performed. The patient then can be put to bed straight off the table and the paraphernalia of the operation all removed before he has recovered from the anæsthetic.

The room should be prepared two days beforehand, cleared of all unnecessary furniture, pictures, curtains and hangings. It should be well washed and damp dusted. In emergencies where this preparation cannot be carried out, the dust should be disturbed as little as possible, any dusting should be

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done with a damp cloth. Damp sheets should be pinned over the carpets and curtains, and a good fire lit to warm the room thoroughly.

Light.—It is important that there should be plenty of light. If the operation is in the daytime a good south window is important, a bay or bow window is better than a flat one. If at night the artificial light should be ample, and it is as well to have a good movable light as well as the ordinary fixed ones.

The Furniture necessary for the operating-room is an operating-table, three small tables, one or two chairs and pails for slops. The operating-table, if a real one can be obtained, is a table about six feet six inches long, and about two feet broad. It is usually in three parts, the head-piece can be raised or lowered, the foot-piece can be lowered, while the middle-piece may be tilted up beneath the pelvis so that the patient can be retained in a position sloping from the knees to the head. A suitable table can often be found in the house, any long, narrow table sufficiently strong will do, the kitchen table is usually of this description, or two narrow tables may be placed end to end. Length is not so very important, except in operations on the leg and foot, for the legs may be allowed to hang over the end. Two boards on trestles make an excellent operating-table. For children a dressing-table or chest of drawers will suit admirably. The table should be arranged so as to procure the best light for the site of operation. It should be covered by a blanket folded lengthways, over which is placed a mackintosh. On this a large bath towel may be spread to soak up any discharge, blood or fluid which may run down. A low pillow should be at

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the head of the table. Underneath the table should be placed a bucket or other receptacle for soiled swabs, towels, etc. A washhand-stand or a table with two basins on it, and a plentiful supply of hot water, should be placed within easy reach. As a rule the preliminary washing can be done in an adjoining bathroom, and this saves the labour of emptying the soapy water and refilling the basins with clean. Small basins with antiseptics, usually biniodide of mercury, are placed on the washstand. After the hands are thoroughly washed and scrubbed and the nails cleaned, they are soaked in the biniodide of mercury or other antiseptics. They should not be wiped on an ordinary towel, but they can be rapidly dried if wished by dipping them in methylated spirit, or they may be put in methylated spirit and biniodide of mercury directly after washing. One table is reserved for the instruments and on it is placed a large flat enamelled tray, or if this is not to hand one or more large, flat-bottomed pie-dishes are best. These are half filled with an antiseptic solution, and the instruments after being boiled are placed in the dishes; in a smaller dish, the ligatures, sutures, needles and knives are placed. On this table also is a small bowl of antiseptic in which the hands may be rinsed. Some people prefer to do without antiseptics and spread over the table a sterile towel on which the boiled instruments are laid. The instrument table is placed in a position where the surgeon can conveniently reach any of the instruments as they are wanted.

A second small table is placed near the head of the operating-table and on this the anæsthetist places the apparatus with which he intends to give

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chloroform or ether, together with the bottles containing these drugs. In addition to this certain things should always be present, they are, a towel and safety-pin for a mask, a mouth-gag, tongue forceps, a swab-holder, a hypodermic syringe with the needle mounted, and with a dose of strychnine or ether ready in the barrel, and a towel and a bowl in case the patient is sick.

On a third table are laid out the dressings, wool and bandages which are to be applied at the close of the operation. In a small room these can conveniently be placed upon the mantleshelf so as to economise space.

The aseptic aprons, towels and swabs are usually supplied ready sterilised in air-tight drums or in tins hermetically sealed. After the patient is under the anæsthetic the surgeon puts on the apron. The clothing of the patient is arranged to expose the area to be operated upon, the skin of which is painted with an alcoholic solution of iodine. The aseptic towels are then arranged to cover in all the unsterilised clothing and clipped or pinned in position so that no instruments can slip down between them and become contaminated. If there are no sterile towels to hand ordinary towels can easily be rendered sterile by boiling for a few minutes in a large saucepan. Or ordinary towels can be put to soak in an antiseptic solution of 1 in 40 carbolic or 1 in 1000 biniodide of mercury and wrung out when needed. In this case mackintoshes should be put underneath the towels to protect the clothing of the patient. For swabs, if none have been prepared, clean handkerchiefs may be used after being prepared in the same way as the towels.

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The patient should be kept warm and well wrapped up during the operation so as not to catch cold, for under an anæsthetic a patient becomes for the time being as a cold-blooded animal—that is, he takes his temperature largely from his surroundings, hence the importance of having a warm room.

Management Immediately after an Operation. After the dressings are applied, if the clothing is soiled it should be changed at once, and the patient put back to bed. The bed should have been well warmed with hot-water bottles, but these should be removed when the patient is put to bed. If they are not removed, they must be covered with thick flannel and put outside the blankets. It is better, however, to remove them altogether, then there is no risk of burning the patient. Burns are extremely liable to occur from hot bottles when the patient is unconscious, and strict precautions should be taken to avoid this, for damages may be claimed in a court of law later. Unless there is some contra-indication the patient should be laid on his side so that if he vomits the fluid will run out of the mouth and not be drawn into his trachea. Under his head a folded bath towel should be arranged to meet this contingency. The patient should not be left alone until he has really recovered consciousness or passed into quiet sleep. If an injection of morphia has been given shortly before or during the operation he is quite likely to go to sleep without really coming to.

If there has been any great loss of blood, the pillow should be removed and the foot of the bed raised about six to eight inches on blocks of wood, bricks or books placed under the feet of the bed, care

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being taken to see that the rollers are not likely to slip off.

In cases of peritonitis as soon as the patient has come round, he may be placed in a semi-sitting position, the back and shoulders being raised by a bed prop or by several pillows. To prevent him slipping down a bolster should be placed beneath the knees, and the ends tied with a bandage which is fixed on each side to the head of the bed.

Vomiting is sometimes troublesome after an operation. If this is the case small sips of water may be given, especially if there is great thirst. If the vomiting persists it is well to allow four to six ounces of water to which there is added a little sodium bicarbonate. This neutralises the acidity of the stomach, and when vomited washes the stomach clear and the vomiting then often stops.

Shock

Shock or Collapse is the term which is used to denote the state of profound depression which is found after extensive injuries and severe operations. Its amount depends largely on the extent and severity of the injury received, also on the site of the injury, being greater when connected with the cerebral centres or with the abdominal or thoracic viscera. The nervous system of the patient also has a good deal to do with the different amounts of shock which are exhibited by different people. Fear and expectation increase shock, hence it is more marked in nervous people. Under stress of excitement as in fighting, wounds may pass unheeded at the time.

Symptoms may be quite slight, as in simple fainting, or may be so severe as to cause death.

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The pulse is slow and weak at first, later very rapid, irregular and almost imperceptible. The respirations are slow and shallow, the face pallid, and the brow covered with cold sweat. The temperature is often subnormal. In fact, all the functions of the body are profoundly depressed. After a variable interval *reaction* takes place, when it is not unusual for vomiting to occur. If there has been great loss of blood, the symptoms due to that are associated with those of shock, and as the latter pass off so the hæmorrhagic aspect becomes more marked.

The Management of Shock after an accident or operation is important. In slight cases the patient is laid flat with the head low; well-protected hot bottles and warm blankets are applied to maintain or restore the body temperature. A little hot coffee or stimulants may be given, or a hypodermic injection of strychnine or ether. Over-stimulation is to be avoided.

Injection of hot saline solution (one drachm to the pint) is one of the best remedies. It is most easily given into the rectum, either in one injection of eight to ten ounces put in slowly with a Higginson's syringe, or better by the continuous method (see p. 383). Shock can be diminished at an operation: (1) by speed in operating, which is helped by having everything likely to be needed ready at hand, so that no time is wasted once the person is under the anæsthetic; (2) by keeping the patient as warm as possible; (3) minimising hæmorrhage; and (4) a hypodermic injection of morphia half-an-hour to an hour before an operation lessens the dread of the ordeal, and also diminishes the amount of the anæsthetic needed.

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CHAPTER XXIV

CHILDREN

A GREAT deal of the information necessary to form an opinion as to the condition of young children has to be obtained from the parents or nurse, but useful though this information is it should never be allowed to replace a thorough examination. To those constantly dealing with the ailments of childhood the appearance of the child is often most significant, while its cry, method of breathing, or crying may be almost diagnostic. Every one dealing with children for the first time has to be told that a child is not simply a miniature adult as people are sometimes apt to think. Children differ from adults not only in having diseases which affect them particularly, but when suffering from diseases common to all ages the effects of the disease in the child may be totally different from its effects in the adult. For instance, acute indigestion with vomiting and diarrhœa going on for some days in an adult may be very unpleasant, but is not alarming, the same symptoms, however, may bring a previously healthy baby to the brink of the grave in twelve hours. Sudden deaths are common, and serious diseases run a very rapid course. One thing must be realised—there can be no delay in treating children.

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History of the Illness.—In all cases in hospital where a nurse receives a child from its guardians for admission into the wards, a history should be obtained and written down before the guardians are allowed to depart. Once they have departed it may be very difficult to obtain any reliable information as to the child. In the majority of cases the doctor does not see the parents.

The following points should be noted: Name, age, full time or premature birth, how fed, vaccinated, previous ailments with their dates.

Family History.—Father and mother, number of children, miscarriages, still-births, cause of death in those children who have died, history and symptoms of present illness, giving dates (not days of the week).

Feeding of Infants.—If the mother is perfectly healthy and has plenty of milk, the best food for an infant is its mother's milk; this it should have for the first six to eight months—it requires no other food. During the time which precedes the appearance of the milk the child should be put to the breast about three times a day. As soon as the milk appears suckle every two hours by day, and twice by night, until the child is three months old; then suckle every three hours by day and once only by night. Too frequent suckling makes the milk poor and does not satisfy the baby. The child should be kept at the breast about fifteen minutes. The mother's nipples should be bathed with warm boracic lotion both before and after suckling. Also wash the inside of the child's mouth with a small piece of clean linen and warm water after taking the breast. This will prevent "thrush."

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Weaning should be done gradually, artificial feeds replacing the breast feeds, so that at the end of a fortnight no breast feeds are given. Between the eighth and ninth months, let the child have three times a day a mixture of two parts of cow's milk and one part of barley water, sweetened with one lump of sugar or one-third of a teaspoonful of malt extract to each bottle. The cow's milk should be just brought to the boil. The nature of the artificial feeds will vary with the age at which the child is fed.

The barley water is made as follows: Wash one tablespoonful of pearl barley and put it in a saucepan with one pint of cold water, let it come to the boil, and then simmer beside the fire for half-an-hour. Strain and use as required; it should be prepared twice daily.

If the mother has insufficient milk, the child should still have it at regular times, the feeds in between these times being cow's milk diluted with barley water.

If, for any reason, the breast cannot be given, cow's milk must be substituted, ordinary dairy milk is better than the milk from one cow. Cow's milk differs from human milk in having about twice as much protein and half as much sugar, while the fats are about equal. To reduce the amount of protein, which forms a hard curd, the cow's milk has to be diluted, this still further reduces the amount of sugar and fat so that these two substances have to be added. The amount of fat to be added is a teaspoonful (one drachm) of cream, which is roughly 50 per cent. fat to every three ounces of milk-and-water mixture. Similarly, a level tea-

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spoon of sugar, milk sugar is best, should be added to every three ounces of the milk-and-water mixture.

If there is any difficulty in digesting the curd, a little lime water may be added, a drachm to each feed, or, better still, a few drops of the saccharated lime water. Another useful addition to the feed, where a firm curd is formed in the stomach, is a solution of sodium citrate made so that in a drachm there is a grain for each ounce of the feed. Each feed should be warmed to 98° F.

The Bottle.—The bottle should be provided with a teat, but no tube. It must be scalded out both before and after use and cleaned with a brush. The milk should be tasted before it is given, to be sure it is not sour or smoked. What is left over from the feed should be thrown away and not kept for the next time.

Quantities.—Up to three months the child should be given one part of cow's milk and two parts of barley water—prepared and sweetened as above—every two hours by day and twice by night. Some babies can be taught to go with no more than one feed at night almost from the start. At first the child should get one and a half ounces of the mixture at each feed, an extra teaspoonful being added for each week, at the same time after the first month a little more milk is added to the mixture each week until—

Between Three and Six Months—the child gets equal parts of cow's milk and barley water, and is taking from one and a half to two pints a day. The feeds are now given at three-hourly intervals by day and vary with the age from about four to six

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ounces. Extra cream may be added or butter melted into the feed.

Between Six and Nine Months.—The mixture consists of two parts of cow's milk and one of barley water, more milk and less barley water being added, until at about nine months the child is taking plain milk.

Do not give any infant foods, condensed milk, bread and butter, biscuits or starchy foods until the child is eight months old, except by orders of a medical man.

The feed should be given regularly at stated times and no food given between meals—"just to keep the baby quiet." Babies are purely creatures of habit and to feed them because they cry is a great mistake, they are not hungry but they may be, and often are, thirsty, especially in hot weather. A little water or barley water flavoured with orange juice will satisfy them.

Between Nine and Twelve Months.—Besides two to two and a half pints of cow's milk, two meals may be added daily of plain milk pudding, porridge made with milk, or bread and milk.

To make bread and milk, put a slice of stale bread without crust to soak in cold water for two hours, pour off the water, beat up the bread, and pour over it a quarter of a pint of boiling milk, sweeten with sugar. This should be made fresh for each meal.

Other foods, such as Robb's biscuits, Allenbury's or Mellin's, may be given with milk. Also gravy, chicken, mutton or beef broth may be added.

Between Twelve and Eighteen Months.—Add to the above, mashed potato and gravy, or a beaten-up egg, custard, and bread and butter. After fifteen months

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feed every four hours during the day and not at all in the night.

After Eighteen Months. — Finely minced or shredded fresh meat, fish or chicken may be added, with vegetables, but cow's milk should be the principal article of diet till over four years old.

Signs of Unsuitable Feeding.—A child whose food disagrees with it does not grow and put on weight as it ought. It suffers from indigestion, and vomits or has wind or colic, and there is either a tendency to diarrhœa or constipation. Any of these results will make the child cry a great deal more than it should do.

Often the cause of this is not the unsuitability of the food, but the quantity and way it is given. If the child bolts its milk quickly, it may easily take too much, with the result that it will vomit later, and may bring up the greater part of the feed so that in the end it gets little benefit from the meal. More children fail to thrive and are actually emaciated from over-feeding than from not getting enough. If it bolts its milk in ten minutes and remains another ten minutes sucking the empty bottle or breast it will swallow air and set up colic and indigestion. Both these conditions can be cured by regulating the feeding, not the food. It is a great mistake to change the food continually before the child has really got into the habit of taking it, just because the child is sick directly after feeding, or cries.

General Directions. *Sleeping.*—The baby should sleep in a cot or basket alone, and not in the same bed as its mother.

Clothing.—Infants are very susceptible to the

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loss of heat. If babies kick off the bedclothes, put them in long flannel night-gowns, fastened below the feet and at the wrists and throat. They should not lie between the window and the door or fireplace and door. The window of the bedroom should be opened a little at the top, and in cold weather a small fire should be kept burning. The clothing should be loose round the chest and close round the abdomen. Children should not be sent out with nothing on below the armpits but petticoats. There should be a flannel binder round the belly. Children, even small babies, should be encouraged to kick and play as much as they like, it is bad to let them sit or lie constantly in one position. No effort should be made to teach children to walk early. Older children should have the legs and arms protected when out of doors. At every age children should be out in the fresh air as much as possible.

Washing.—A baby should be washed all over with soap and warm water night and morning in a warm room; soft soaps are less irritating to delicate skins than hard soaps. They should be well dried and powdered, special attention being given to the deep folds where the skin surfaces come in apposition. (See *Intertrigo.*)

Teething.—Children often suffer considerably, and are nearly always fretful during the time they are cutting their first teeth. Teething usually commences about the seventh month and ends at the end of the second year. The teeth appear in the following order, the lower central incisors, the upper central incisors, upper lateral incisors, lower lateral incisors, first molars, canines and back molars.

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Though this is the usual order of appearance considerable differences may be met. When the child is twelve months old it should have eight teeth. During dentition the gums become inflamed and the catarrh may spread to the nose, lungs or down the intestine, so that colds, bronchitis and intestinal disorders are frequent; in addition, the glands under the jaw may become large and tender and sometimes convulsions occur. Greater care is, therefore, needed to keep the mouth clean at this period. The child should be allowed to bite on a hard clean substance; it is only rarely that lancing of the gums is necessary.

Thrush is the growth of a parasitic organism which takes place in the mouth of children who are not properly looked after. Whitish patches appear on the mucous membrane of the cheeks, palate and gums, these patches cause inflammation and sometimes ulceration. As a rule it is accompanied by gastric and intestinal disorders, so that the stools are offensive and irritate the buttocks unless the diapers are changed at once. Thrush is more likely to affect weakly than robust children.

Management.—The mouth should be cleaned out after each feed, and the white patches wiped gently with pieces of clean linen dipped in borax and honey or a weak solution of alum, three grains to the drachm. Attention should be paid to scalding and disinfecting the bottle, teat, and milk receptacles, at the same time the irritating contents of the bowel should be cleared with a few drops of castor oil.

Epidemic Diarrhœa and Vomiting, sometimes called infantile cholera, is an acute and most severe affection which affects the infants of large towns.

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It attacks the children of the poorer classes chiefly, but those of the upper classes are not immune. The hot months of the summer and early autumn are worst. The disease is caused largely by bad and contaminated milk which does not keep well during the summer heat, and is easily infected by dust, flies or other causes—chills may predispose the child to the disease. Often the acute disease is found accompanied by large numbers of cases of the milder forms of diarrhœa, brought about probably by the same cause.

Symptoms.—There is mild diarrhœa at first which becomes rapidly worse until the stools number eight, ten or even twenty in the twenty-four hours. The stools vary, but at first are green and very offensive, later they may be lighter in colour and frothy from fermentation, and may contain mucus and even blood. The vomiting starts and is urgent, nothing being kept down; the vomit is acid and sour. The general symptoms develop rapidly, though the child cries and strains violently to begin with, this soon ceases from lack of strength. With the constant abstraction of fluid, the child seems to fall in, the eyes become sunken, the fontanelle is depressed, the skin wrinkled, and all the tone goes from the muscles, so that the child lies pale and exhausted. The tongue becomes dry and coated, and face pallid with the eyelids drooping, but not closed. The temperature may be raised to 100–103° at first, later, as the child becomes collapsed, it may be subnormal; the limbs are cold. The infant may die from exhaustion or syncope and the whole illness may not exceed two or three days' duration.

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Management.—During the hot months, especially when an epidemic of diarrhœa prevails in the neighbourhood, great care should be exercised in the preparation of the infant's food. The milk should be sterilised by boiling and should never be left exposed, but should be covered by a clean piece of gauze to keep off the flies. Any tendency to diarrhœa should be treated seriously and a doctor consulted. At these times it is common for a doctor to order condensed milk to be given in place of cow's milk, but this practice should not be continued longer than is necessary; mothers are apt to continue the use of these condensed milks to the detriment of the child's health. Purgatives should be avoided, if castor oil is needed three drops in milk three times a day for two or three days are quite sufficient. If the child begins to get sick and the diarrhœa continues all milk should be stopped at once, and albumin water given at short intervals. The children are very thirsty and sips of water are greedily taken and are of great benefit. If the symptoms subside whey may be added to the albumin water after two or three days, and after a similar interval a little milk may be added. If the child is exhausted three to five drops of brandy may be given in water four hourly. The child must be kept warm and carefully covered, and hot flannels applied if the temperature is subnormal. Hot saline enemata may do much to alleviate the diarrhœa by clearing out the irritating and fermenting contents of the large bowel; a considerable amount may be absorbed and help to replace the fluid lost. These wash-outs should not be given oftener than twice or at most three times in twenty-

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four hours, or they may be a cause of irritation themselves.

Rickets is a disease due to improper feeding, and therefore is common among the poorer classes. Among the many factors which seem to produce the disease, the deficiency in the cream or fat of the food seems to be one of the most important. It therefore appears chiefly among those infants who are not fed on the breast. Cow's milk when diluted is deficient in cream, and practically all the condensed milks on dilution are far below the necessary standard in this respect.

Symptoms usually appear after the sixth month or shortly after the child is weaned, rickets seldom starts after the second year.

Being a disease of malnutrition rickets affects every system of the body. The child is often fat to look at, and is large and heavy for his age, but is soft and the muscles are flabby. The digestive system is constantly upset to a slight extent, there is colic, wind, the motions are only partly digested, and are offensive, slimy and green. The abdomen is enlarged. The child is irritable, fretful, seems abnormally tender, as if there were pains in the limbs. He perspires very freely, especially at night, particularly about the head, so that the pillows may be soaked, the bedclothes are kicked off and chills result. The child is backward in everything, the teeth are late, irregular and soon decay; he is late in attempting to stand or walk, and usually sits with the legs crossed and the back bowed forward.

The nervous system shows its instability by fits, and spasms of the glottis, called laryngismus or false

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croup, which are alarming at the time, but seldom dangerous. Tetany or peculiar contractions of the muscles occur, chiefly of the extremities, whereby purposeless movements are performed. Respiratory troubles, in the form of bronchitis and pneumonia, are very common and have a marked influence in producing deformities of the chest.

The most marked and permanent symptoms are seen in the bones, these cannot grow properly owing to a deficiency in the elements necessary for the formation of new bone. The growing ends of the bones, therefore, become enlarged by the laying down of soft bone, so that the wrists and ankles become thickened. The head is large and square—box-like—and the fontanelle remains open longer than usual and often increases in size. The growing ends of the ribs are enlarged and can be felt as nodules on each side of the sternum constituting the rickety rosary. The bones, too, are softer than usual, and green-stick fractures are very common, while the weight of the body in walking or standing causes bending of the bones of the lower limbs; the difficulties of respiration cause the ribs to fall in and the sternum to be pushed forward, constituting pigeon breast. Even if the child cannot stand the legs may be bent by being always crossed in the same position, and the back becomes curved as the weak muscles fail to support it.

Rickets is rarely fatal in itself, but the weakened system may be unable to withstand the attacks of other diseases, such as diarrhœa, lung troubles, convulsions, etc., which are common complications.

Management.—The first thing to do is to rectify the faults in the feeding and to ensure that the

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cause of the trouble in this respect is put an end to. The starchy foods should be forbidden, plenty of good milk ordered with extra cream added. Raw meat juice may be allowed. One of the many preparations of cod-liver oil should be given in drachm doses three times a day.

The hygienic conditions must then be attended to, and the ventilation of the room inquired into. The child should sleep in a cot by itself, out of a draught, the bedclothes should be warm and light, and so arranged that they cannot be kicked off easily. The child should sleep in flannel clothing tied together beyond the feet, a flannel binder should protect the abdomen from chills, there should be shoulder straps to prevent the binder slipping. The bedclothes should be well aired. During the day the clothing round the chest should be loose, that round the abdomen close fitting. Stockings should be worn to above the knees. Rickety children should be out of doors most of the day in fine weather. If they cannot walk, they should be taken out in a perambulator. They should not be carried in the arms more than is necessary, especially by other children.

Bow Legs.—If there is any tendency for the legs to become bowed or knock-knee to develop, or if these deformities have developed already, the child should be taken completely off his feet and not allowed to stand or walk. The best way of doing this is to fasten straight splints to the outer side of the child's legs, long enough to extend from the knees to some inches beyond the feet. These will effectually prevent the child from standing. The splints must be carefully padded. They can be

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taken off at night-time, the legs well rubbed, and the muscles worked from the foot to the trunk. The rubbing is repeated in the morning before the splints are again applied. When the limbs are relieved from the child's weight they tend to straighten out of themselves.

A Crooked Back is the most serious deformity produced by rickets and should never be neglected. The child should at once be put and kept upon its back, and not allowed to sit or be carried in the hunched-up position which has produced the deformity. If the child is fastened to a small board it can be carried out into the open air or placed in a perambulator. The muscles of the back should be rubbed gently night and morning. The child must be cared for in the lying-down position completely for many months, not only until all signs of rickets have disappeared, but till the muscles of the back are strong enough to support the back.

Hernia or Rupture.—Hernia is a very common condition in children. It is often caused by children contracting their abdominal muscles unduly, either by crying, usually the result of bad feeding and consequent indigestion, or straining from constipation or difficulty in passing water or by continual coughing. If the treatment is to be successful it is very necessary to remove any of these causes of straining.

There are two great classes of hernia in children, the umbilical hernia and the inguinal hernia.

Umbilical Hernia, or "starting of the navel," is the protrusion of the navel owing to the increased abdominal pressure driving the contents of the abdomen out through this weak spot in the abdominal

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wall. The scar which forms when the cord separates is weak and easily stretched, so that a small protrusion occurs; a piece of intestine enters the protrusion, and being pressed upon causes colic, which in turn induced crying and further increase of pressure inside the abdomen, so that the condition always tends to make itself worse.

Management.—To prevent the hernia forming a firm binder should be kept round the belly of the infant during the first few months of life, as it is only during the early weeks before the scar is firm that the protrusion is likely to develop. When it has developed any cause for the extra straining must be inquired into, the feeding corrected, the bowels regulated, and circumcision performed if that is necessary. Locally a small pad of lint is placed over the navel after the protrusion has been pushed back with the finger. Over this pad a piece of tin, hard cardboard, or thin piece of wood, about three inches in diameter is placed and fixed in position with a piece of strapping, which should extend well outwards to the flanks so as to obtain a good grip of the skin. Another piece of strapping should be placed vertically in the middle line so as to prevent the tin from slipping up or down. Over all a flannel binder is worn. The strapping is removed once a week and its presence need not prevent the child being washed and attended to as usual. If it becomes loose it must be renewed immediately. The common practice of using a penny is not good, as the coin is too small and is easily displaced by the hernia when the child cries or strains. The treatment should be continued until the hernia is cured. In early cases two or three months is

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sufficient, but if the hernia has been allowed to get large, a year may be needed to bring about a complete cure.

Inguinal Hernia is more common in boys than in girls. A swelling is seen to come up in the groin when the child cries; as a rule, it recedes again when the child stops crying. Its presence, however, is painful, and just as in the case of the navel rupture, it induces more crying and straining. Some of these swellings increase to a large size and come right down into the scrotum.

A doctor should always be consulted, as there are many different forms of swellings which may develop in this region and only a doctor can tell them apart.

Management.—As in the last case the cause of the straining must be corrected. The mother should be told to press back the swelling when the child cries. As a rule, some form of support or truss is ordered so as to prevent the rupture from coming down. The most suitable form of truss for small infants is made out of a skein of wool or a soft flannel bandage. A loop is made by doubling the skein on itself. The child is placed on its back and an opportunity taken when it is not crying or when the rupture is not down. If the rupture is down the contents must be pressed backwards and upwards into the abdomen, and the finger kept on the place to prevent them reappearing, no force should be used. The looped end of the skein is laid over the place where the rupture appears, and the end carried round the back of the pelvis, below the iliac crest to reappear on the opposite side of the body, from here the end is carried to the starting-

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point across the lower part of the abdomen and threaded through the looped end, and then taken between the legs and tied off to the transverse part behind. Additional power may be gained by slipping a flat pad under the threaded loop and fixing it with a safety-pin to the wool. The mother should have two trusses. The child is bathed with one truss on. After drying the child, the wet truss is removed and the skin dried and powdered, while the mother controls the rupture with light pressure of the hand till the dry truss is applied.

If the hernia comes down under the truss, this should be removed, the hernia put back and the truss re-applied; the truss should not be left on with the rupture down.

In older children, and those in whom the rupture is too large to be controlled by this means, some form of spring truss should be worn. In young children a cure can be brought about. Trusses are little use if, in spite of them, the hernia descends. After two years a cure can scarcely be hoped for, and it is better to have a radical cure by operation, which is a very safe procedure.

Strangulated Hernia is extremely serious and when neglected is often a fatal condition. Strangulation occurs when the bowel comes down into the hernia and gets jammed, so that it cannot be reduced into the abdomen again. Owing to the tight pressure the circulation stops in the gut, and in a few hours the gut will die unless it can be relieved either by getting the gut back or by operation.

Symptoms.—If the child is known to have a hernia, the mother would naturally see if this was down as soon as her attention was attracted by the screams

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of the child. She would then find that the hernia was down and that she was unable to get it back. If, however, the rupture develops suddenly or is small, it may escape notice. The child screams and strains from the pain of the condition. Vomiting comes on and all food is refused or brought back as soon as it is taken. The vomit at first is the contents of the stomach; later the contents of the intestine are returned, as yellow offensive fluid. The bowels no longer act, as nothing can pass down the crushed bowel. The child rapidly becomes exhausted, the face pale and sunken. Death follows if the condition is unrelieved. When children suffer from hernia their mothers should be warned to seek medical aid in all cases when the hernia cannot be reduced, when the child screams in paroxysms, or where vomiting of this nature comes on.

Obstruction of the Bowel in children is usually caused by one of the two conditions—strangulated hernia just described or by intussusception.

Intussusception is the passage of one part of the gut into another so that complete obstruction and strangulation is brought about. It is more commonly met in children under twelve months of age than at any other time, most commonly at about eight months, just when extra food is being given to the child. It is usually caused by errors in diet. It is commoner in boys than in girls.

Symptoms.—These are very striking and should instantly attract attention. The infant, usually healthy and strong, is taken with paroxysms of screaming, draws up its legs and strains hard, as in strangulated hernia. Vomiting begins soon after-

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wards and is continuous. The next and most striking symptom is the passage from the bowel of blood and slimy mucus. A portion of the bowel may actually protrude from the anus. If the child is not treated it passes through the same stages as in strangulated hernia, and unless the intussusception is relieved the vast majority of children affected die within a few days. With children or in adults, the condition may become chronic, the passage not being completely occluded.

Enlargement of the Tonsils and Adenoids.—Children are peculiarly liable to suffer from infections of the tonsils and adenoids, and these appear in the form of sore throats, colds in the head, coughs and bronchitis when the catarrhal condition spreads periodically. Septic infection of the mouth from decaying teeth is often the cause of such conditions.

After a time the tonsils and adenoids become permanently enlarged and obstruct the natural passage of the air through the nose, as a result the child keeps his mouth open so as to breath easily. Enlargement of the tonsils and adenoids has very far-reaching effects. The increased secretion being continually swallowed is very liable to upset the digestion of young children. The septic material in the recesses of the tonsil is absorbed, and the child always appear delicate and liable to get upset easily. The condition termed debility in children is more often due to this cause than to any other. The absorption of this septic material causes enlargement of the glands of the neck and may form abscesses or pave the way to the onset of tubercle in the glands later. The obstruction to breathing and the frequency of chest complaints causes the

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chest to be ill developed, and possibly deformed. The blood does not get the right amount of oxygen and the mental development suffers so that the child is backward and dull.

The nervous system suffers in other ways, as wetting the bed at night may often be traced to this cause.

The accumulation of adenoid tissue at the back of the nose partially blocks the passage of air up the auditory tube to the ear, so that pain and even suppuration in the ear may occur at the time, or it may lay the cause of deafness in after years. From an enumeration of some of the effects of enlarged tonsils and adenoids, it will be gathered that it is a serious condition, and parents should be on the look-out to correct it. Snoring at night may be a symptom, but often this is not present.

Management.—The child should be examined by a doctor, all septic teeth should be dealt with, and later the tonsils completely removed and the adenoids cleared out. The operation is not a dangerous one, nor is it extremely painful. The child should be kept in bed for three days, after that he can be allowed up. This, however, is not sufficient, it is most important to teach the child the proper method of breathing through the nose. Some care is needed to do this, as if the child has always breathed through the mouth the habit requires time to correct. Put the child on its back three times a day, for half-an-hour at a time, and make him breath in and out as deeply as possible through the nose, the mouth being kept shut. A tonic is also useful in bracing up the child. In

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nearly all cases there is a marked improvement in the health at once.

Intestinal Worms.—These are very common in children from drinking bad water or eating improperly cooked foods. There are three common forms, threadworms, round worms and tapeworms.

Threadworms.—These are minute white thread-like worms about half-an-inch long. They live in the large intestine and may give rise to peculiar symptoms, restlessness, itching, inability to hold the water, especially at night, and sometimes even convulsions. They can only be diagnosed with certainty by examining the motions, when they are easily seen.

Management.—These worms are easily got rid of. A dose of castor oil should be given at night, next morning wash out the bowel with salt and water, two tablespoonfuls of salt to a glass of water. The saline should be retained as long as possible. When it is returned large numbers of worms will be seen. A salt-and-water enema should be given night and morning for three days, then there should be three days' break and the process repeated. An infusion of quassia may be used instead of the salt and water, but is not so good. The enema should always be given through a well-oiled catheter; the hard vulcanite or glass tube should not be put into the bowel.

Round Worms.—These resemble ordinary earth worms in size and shape, but are white or yellowish white in colour. They live in the small intestine and are occasionally vomited from the stomach. They are a cause of malnutrition and may give rise to convulsions.

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Tapeworms.—These are long worms, often many feet in length, they have a small head which fastens on to the mucous membrane of the small intestine, behind the head the worm broadens out into a flat tape-like body made up of many segments joined together. These segments break off and are passed with the motions and so betray the presence of the animal. There are seldom any symptoms associated with its presence, except a large appetite and sometimes diarrhœa.

Management.—To rid the alimentary canal of these two large parasites certain drugs are prescribed either santonin, or extract of male fern. The child should be given a small dose of castor oil at night to clear the bowel, the powder or medicine is given next morning after the bowels have acted. No food should be given till mid-day and then only such food as will leave little or no residue. In the evening a larger dose of castor oil is given. Next day the same thing is repeated. The stools should be examined to see if the round worms are passed.

In the case of the tapeworm many segments will be seen, but these are not important, it is essential that the head be got rid of or the worm will again grow, and after a few weeks fresh segments will appear, and another attempt must be made to get rid of the head.

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CHAPTER XXV

NURSING APPLIANCES AND ADMINISTRATION OF MEDICINE

Nursing Appliances

Baths.—In addition to the ordinary cleansing bath, baths are ordered for a variety of purposes, and are given at different temperatures.

A hot bath is about 104° F. and upwards.
A warm bath about the body temperature, 98·4° F.
A tepid bath about 92° F.
A cold bath 85° down to 65° F.

The bath thermometer should always be used; especially is this needed when dealing with children.

A Cold Bath is given in cases of hyperpyrexia. In many cases it is not considered advisable to lower the patient directly into the cold water, the temperature to begin with being as high as 85° F., and is cooled down by the addition of cold water. The patient should not be chilled too much.

A Hot Bath is given to relieve pain in renal colic, to sooth excitement, in cholera and delirium, to relieve retention of urine, and to promote perspiration in uræmia. These baths are usually given at the bedside, the patient being lifted into them from the bed.

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Local and Continuous Baths.—*Local Baths* are given when it is not desirable to immerse the whole body, or when it is necessary only to treat certain parts. Hip-baths are given in disease of the pelvic organs; in this case the shoulders and legs of the patient should be covered with a blanket. A foot-bath is often given to people who have been severely chilled, mustard often being added to the water.

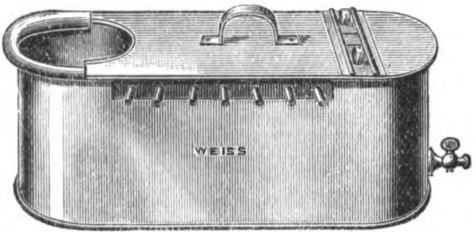

FIG. 89.—Limb bath.

Continuous Baths are given in cases of extensive burns, skin diseases and severe surgical injuries, when the patient may be kept submerged, with the exception of the head, for days. A nurse should always be present, and the temperature kept at a comfortable level. Continuous baths are most often applied to septic limbs, when an antiseptic, such as iodine, is added to the water.

Medicated Baths.—*Sulphur Bath.*—One ounce of potassa sulphurata is required for every five gallons of water. The sulphur should be first dissolved in boiling water and then added to the bath.

Iodine Bath.—To every pint of water one drachm of tincture of iodine is added. This is usually given as a local bath for a limb.

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Alkaline Baths are prepared by adding six ounces of carbonate of soda, or potash, to a hot bath. This bath is given for rheumatism.

Brine Baths are prepared by adding about one pound of common salt to five gallons of hot water.

Hot-air Baths.—These are invaluable in inducing sweating in kidney disease. Special apparatus is used, usually Allen's lamp with the boiler removed. A mackintosh is laid on the bed with a blanket over

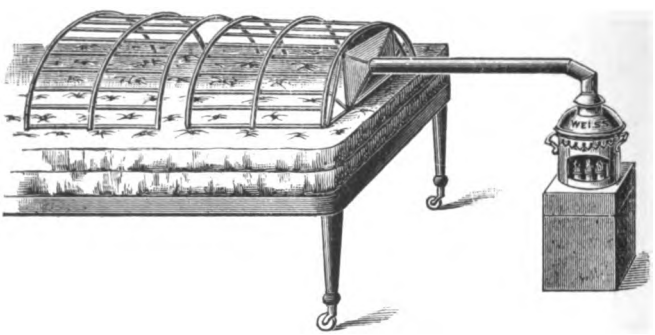

FIG. 90.—Hot-air bath.

it, the patient is stripped and lies on the blanket, and is loosely covered by another. Two wicker body cradles are placed over him, and these are covered by two blankets, over which a mackintosh can be placed, and over that again another blanket. Everything is tucked in well round the bed, so that only the patient's head is outside. From the foot of the bed the loose blanket covering the patient is withdrawn, and the lamp lit. The spout, guarded with asbestos to protect the blankets, is introduced at the foot of the bed, above the level of the patient. The head of the patient should be wrapped round

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with a damp towel, and plenty of fluid given him to drink. Fifteen to thirty minutes are sufficient for the bath; the patient should not be left alone during that time. The temperature inside the cradles may be from 110° to 150° F., the latter can only be borne by those who are used to such baths. The patient perspires very freely. At the end of the time the lamp is put out, the tube withdrawn, the cradles removed, and the patient left lying between blankets for an hour, till he has done sweating. He should then be sponged down and clean nightclothes given him.

Vapour Baths may be given in the same way, steam being introduced instead of air, the temperature varying from 100° to 110° F., bronchitis kettles or even ordinary kettles being used, paper spouts being attached to them. These baths can also be given in a sitting posture, the patient sitting in a wooden chair and the lamp placed underneath, a tent-like arrangement of blankets being made round him.

Mercurial Vapour Bath.—To give this a patient must be sitting upright in a chair. The same apparatus is used as in the vapour bath. A small dish containing the amount of calomel prescribed is placed over the spirit-lamp under the chair. The calomel is converted by the heat of the lamp into vapour, which is carried upwards by the steam and deposited upon the patient's body. The patient must not be rubbed down, or the calomel would be wiped off and no benefit follow. He should be put back to bed in a warm flannel garment.

Hot Pack.—Prepare the bed by rolling under the patient a long mackintosh with a blanket over it.

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Cover the patient with a blanket. Take a large sheet, fold it across into four. Wring it out in water as hot as possible, using a sheet or large bath towel as a wringer. Lay the patient on his back in the bed, lay the hot sheet over him, moulding it well into the neck and down the sides. Turn up the sides of the blanket he is lying on. Cover with a mackintosh and plenty of blankets. Hot drinks promote perspiration. The patient should remain in the pack for twenty minutes. Take away the wet sheet, blanket and mackintosh, and cover up the patient with a hot, dry blanket and leave him for an hour.

Cold Pack.—Prepare the bed as for a hot pack, wrap the patient in a sheet wrung out in cold water. If the feet become very cold a hot bottle may be put on them. The sheet must be kept cold by being rubbed down with pieces of ice, or by being constantly sprinkled with iced water. The temperature must be taken every five minutes, and the pulse watched. The duration of the pack depends upon its effect on the temperature.

Tepid Sponging is employed with great benefit in cases of restlessness and sleeplessness during fevers; it reduces the temperature and promotes the comfort of the patient. A blanket and a mackintosh, if at hand, should be rolled under the patient, who is then stripped and covered with a blanket, and bath towels tucked in on each side if there is no mackintosh. The skin is slowly sponged over with water at a temperature of 116°, to which some vinegar has been added, only a small portion of the body being exposed at a time. The sponge should be passed two or three times over the skin, special

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attention being given to the great vessels at the root of the neck and the groin. The parts are dried by light dabs with a soft towel. For night sweats the process should be carried out rapidly. The patient then puts on fresh nightclothes.

Enemata are injections of fluid given into the lower bowel. They are given in various ways, either by an indiarubber tube and funnel, or a tube attached to an ordinary glass syringe, or by means of a special instrument, such as a Higginson's syringe. This latter is made of indiarubber, and

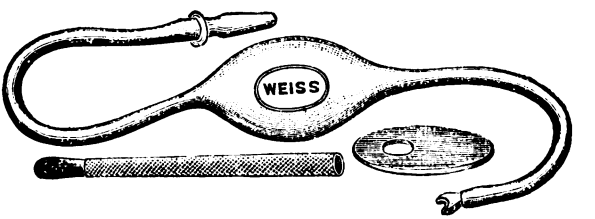

FIG. 91.—Enemata syringe.

furnished with valves, so that merely squeezing and releasing the rubber ball pumps on the fluid. These syringes are often furnished with several patterns of stiff nozzles, but when injecting fluid into the rectum, it is much safer and less painful if an ordinary piece of rubber tubing be inserted and the nozzle fitted on to the tubing. The indiarubber is apt to become stiff and to crack in cold weather, and should not be kept coiled too closely. The rubber also perishes very rapidly. Warm water should be pumped through the syringe before use, to make sure it is clean. If the patient is too ill to be disturbed he can be given an enema when lying on his back with the knees bent. Most

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usually, however, he is placed upon his side near the edge of the bed. A mackintosh and towel should be tucked under the buttocks to protect the bedding. The fluid to be injected is placed in a suitable receptacle on a chair close at hand. The rubber tube attached to the nozzle is oiled or smeared with vaseline, and the syringe filled with the fluid to expel the air. The tube is then gently inserted through the anus for a distance of three to four inches. The fluid is then slowly injected. The towel should be pressed against the buttocks as the tube is withdrawn. The patient should remain quiet for some time, in order to retain the fluid for about fifteen minutes. The bed-pan or night-stool should be at hand. If there is any difficulty in introducing the tube, no force should be used; this is specially important when using the unprotected nozzle, in conditions such as piles or prolapse, as the point may easily be made to penetrate the mucous membrane with most serious consequences. Nothing is better, easier to introduce, more comfortable or safer than a No. 12 catheter.

Different Kinds of Enemata are given for different purposes; large enemata containing some irritating substance are given to clear out the contents of the bowel, these may be of soap, turpentine or oil, the latter breaks up hard masses and facilitates their passage.

The *Simple or Soap Enema* is made of ordinary soap and warm water; for an adult two or more pints may be given. For children, simple warm water should be used, as soap causes a puzzling rash one or two days later; four to ten ounces

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is sufficient. A *Turpentine Enema* consists in adding half to one ounce of turpentine to the ordinary soap-and-water injection. For the *Oil Enema* half to two pints of warm olive oil may be used.

Nutrient Enemata are intended to be absorbed, and are made small in quantity, not exceeding four ounces, so as to be retained. They are useful in cases which cannot be fed by the mouth, as in persistent vomiting and gastric diseases. They are warmed to the body temperature, and then injected slowly by means of a catheter and a glass syringe. The patient should be disturbed as little as possible. A good enema is strong beef-tea, three ounces, the yolk of an egg, and half-an-ounce of brandy beaten up together. Other substances, such as cream and meat extracts, are often given, and the whole may be artificially digested beforehand by adding some liquor pancreaticus.

Medicated Enemata are sometimes give for local conditions, such as ulcerations of the rectum, or to relieve pain. They are small in amount, not exceeding four ounces. The opium enema is the commonest, made up of two to four ounces of mucilage of starch and a drachm of laudanum.

Saline Enemata or Infusion has been mentioned and described in the treatment of hæmorrhage and shock. It is made by adding a teaspoonful of salt to a pint of warm water. A pint is injected slowly so that it is retained, it can be repeated in two to four hours' time.

Continuous Saline may be given into the rectum by means of a douche-can. A catheter is attached to the tube of the douche-can, and the tap partially

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turned so that the fluid only drips slowly from the end. The catheter is then inserted well into the bowel, and the douche hung on the foot of the bed, and packed round with towels to keep in the heat. In this way, the bowel may absorb a pint an hour. After two or three pints have been absorbed, the catheter is withdrawn. It can be reinserted in four hours' time. If there is no tap, then the douche-can must be placed on a level with the body, so as to act as a reservoir, raising the can will only distend the bowel and cause it to contract and expel the fluid. The fluid must be absorbed, not driven in.

A *Vaginal Douche* is given with a Higginson's syringe. A special glass nozzle is used, about five inches long, with holes perforated in the sides of the end portion. The patient lies near the edge of the bed on her back, with the knees bent, with a bed-pan underneath the pelvis. The bed is protected with a mackintosh and a towel. Those who have to administer the vaginal douche to themselves usually make use of the ordinary douche-can, which consists of a reservoir holding two to four quarts, from the bottom of which passes a rubber tube fitted with a tap, and to the end of this is attached the vaginal nozzle. The can is filled with the fluid to be used and placed or hung above the level of the patient. After the nozzle is inserted the tap is turned on. The douche should be used warm. Weak carbolic 1 in 60 may be used or Condy's fluid a drachm to the pint.

The *Nasal Douche* consists of the same apparatus, to which a suitable nozzle for the nose is attached. The patient is directed to hold the nozzle in one

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nostril and lean over a basin; he breathes through his open mouth. The fluid is allowed to run, and enters one nostril, passes round the back of the septum to escape from the other.

FIG. 92.—Nasal douche.

Ice-bags are used to apply cold locally in inflammation to reduce congestion. They are usually indiarubber bags with a large opening, through which the ice is introduced. They may be improvised by placing pounded ice in a thin mackintosh and raising the corners and tying tightly below the free margin, so as not to allow any fluid to escape. The ice-bag should not be heavy, and when applied should be fixed lightly in position; this is especially important in children and frail old people, as frost-bite may easily occur in the tissues to which it is applied. Coils of metal tubing called Leiter's tubes are sometimes used. The tubing is applied, and iced water allowed to trickle through it. Such appliances are seldom to hand, and have no advantage over the ice-bag.

Poultices and Fomentations or Stupes.—These preparations are used to apply heat and moisture to an inflamed surface; the older methods of linseed meal and bread poultices are now rarely used, as these substances have no action apart from the

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heat and moisture they possess, and the same effect can be obtained by other and less troublesome means. They are, however, frequently used by the laity, and a practical knowledge of how to make them is most useful.

Linseed Poultice.—To make a poultice, a board, a bowl, a kettle, a jug of boiling water, and a large spatula or knife are required; also muslin or linen on which to spread the poultice. After the knife and bowl have been heated, a sufficient quantity of boiling water from the kettle is poured into the bowl. The linseed is then added, being quickly sprinkled in with one hand, while the mixture is stirred with the spatula. When sufficient meal has been added the mixture will come away clean from the edge of the bowl, and should be turned out on the linen, and spread evenly and quickly with the spatula, the latter being dipped in boiling water between each stroke. The layer of linseed meal should be a quarter of an inch thick, and it should be spread to within one inch of the edge of the linen, when the former should be folded in all round. Care should be taken not to apply the poultice too hot; this can be prevented by first testing it on the back of the hand. When placed in position the poultice should be covered with jaconet and a thick layer of cotton-wool, and secured by a bandage.

Mustard Poultice.—This is mustard mixed with linseed, the mustard being mixed separately with lukewarm water and then added to the linseed poultice. The proportion of mustard to linseed varies with the object of the poultice, being either of equal parts, or one of mustard and two of linseed.

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Bread Poultice.—A piece of stale bread should be crumbled into a basin, and boiling water added and stirred. The basin is then covered, and placed by the fire for about five minutes. The water is poured off, and fresh boiling water added, and again poured off. The poultice is then spread on muslin and applied. It is very soft, and is well suited for small parts, such as fingers.

Fomentations or Stupes are best made with thick soft flannel, spongiopiline, or lint, but lint is thin and a large piece is required folded many times, if the heat is to be retained.

The material for the fomentation should be folded to the required size, and is placed inside a towel or a special wringer and laid across a hot bowl, the ends of the towel or wringer projecting over the sides. Boiling water is then poured over it into the basin, after which it is wrung out dry by twisting the towel, taken out and applied as hot as the patient can bear it. A piece of jaconet is then laid over it, and this should project well beyond the margins of the stupe. Wool is then laid on and the whole fixed with a bandage.

The *Turpentine Stupe* is used as a counter-irritant. Two to four teaspoonfuls of turpentine are added to the flannel before the hot water is applied, the wringing distributes the turpentine throughout the flannel. Care must be taken to see that blistering does not occur.

Opium and *Belladonna* are sometimes applied on stupes, half-an-ounce of the tincture of opium (laudanum), or half a drachm of the tincture of belladonna, being sprinked on the flannel, after being wrung out of the hot water.

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Mustard Leaves are often used as counter-irritants. The leaf is soaked in tepid water for a few minutes, and applied with the mustard surface next the skin, and secured in place with a bandage.

Cupping is used to abstract blood locally, there are two methods of doing it. Dry cupping and wet cupping.

Dry Cupping is used to draw blood into the superficial tissues without effusion taking place. The part to be cupped is sponged with warm water, and a suitable glass cup chosen which will fit the surface. The edges are annointed with vaseline, a few drops of methylated spirit are poured into the cup and shaken round to moisten the sides, the surplus is poured back. The spirit in the cup is lighted, and the flames spread all over the moistened surface. The cup is then clapped on to the skin surface and pressed firmly in place. The flame is extinguished immediately, and the air being exhausted in the interior of the vessel, the skin rises up inside, forming a considerable swelling.

Wet Cupping should only be carried out by the doctor, and is seldom used. Several small incisions or a number of punctures are made in the skin, and the cup applied as in dry cupping. The blood escapes and fills the cup, which is removed, emptied, and can be applied again. The part is then dressed and bandaged.

Suppositories are used to introduce drugs into the rectum. The drug is mixed up with cacao butter or other fatty substance, which will melt at the body temperature and let the ingredient be absorbed. They are made bullet-shaped so as to be introduced easily, they must be inserted well

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beyond the sphincter muscle. The commonest drug used is morphia, one quarter to half a grain being made up in each suppository.

Glycerine suppositories are used in constipation. Nutrient suppositories are concentrated extract of meat made up in the same form so as to be easily introduced. They should be moistened before insertion.

Throat Applications.—*Gargles* are employed as cleansing applications to rid the back of the throat and tonsils of irritating or septic material. The method of application need not be described. Small children cannot gargle, and older ones can only do it if taught.

Sprays are often preferred to gargles in ulcerated and painful throats. The throat spray works on the same principle as the ordinary scent spray. The fluid is poured into the bottle, and some form of pump, usually a rubber ball with valves, is used to force the fluid out through the nozzle. Mild antiseptics and soothing applications can be made in this way.

Inhalations are very useful in throat, bronchitis or lung conditions. Special inhaling jugs may be obtained, but an ordinary jug can be made to answer quite well if the upper part is wrapped round with a towel, so as to leave a small orifice, through which the steam escapes. The jug is previously filled three-quarters full of boiling water, to which certain drugs have been added. The mouth is brought gradually to the opening, and the steam inhaled through the mouth and breathed out through the nose. The breathing is continued for fifteen minutes, or longer; the best time to take inhalations is at night, as coughing is often apt to prevent sleep. If taken during the day the patient

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should not go out into the cold immediately afterwards.

The following will be found very useful inhalations—

1.	Compound tincture of benzoin	1 fluid drachm
	Water at 150° Fahrenheit . .	1 pint
2.	Oil of pine	5 minims
	Light carbonate of magnesium	4 grains
	(diffused in) water	1 fluid drachm
	Water at 150° Fahrenheit . .	1 pint

Eye Washes should be applied warm, and care must be taken to see that they reach every part of the conjunctiva or mucous membrane covering the eye-ball and lining the lids.

The patient sits in a chair with his head thrown well back. If it is a child the recumbent position is best. The finger and thumb are placed one above and the other below the eye and the lids held everted. With the other hand the fluid is dropped in at the inner corner of the eye and allowed to run out at the other, where a bowl or towel is held ready to catch it. The wash is best applied by using a small piece of clean wool as a sponge and squeezing it over the inner corner of the eye. During the flow the patient should be directed to look in different directions successively, so that the fluid flows all over the eye-ball.

Eye washes—

1.	Boric acid	5 grains
	Liquid extract of opium . .	1 fluid drachm
	Distilled water	to 1 fluid ounce
2.	Solution of perchloride of mercury	1 in 6000

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Applications to the Ear.—To syringe the ear a good large syringe should be used. Two bowls are needed, one to hold the fluid, the other to catch it, the patient holds the latter close to the under part of the ear, his neck being protected by a towel. The warm water or antiseptic lotion is drawn into the syringe and the air displaced. The nozzle of the syringe is directed to the upper part of the roof of the auditory meatus, the nozzle must never be pushed into the meatus, the fluid passes to the end and returns along the floor. Syringing the ear frequently induces coughing. Children sometimes put beads, boot-buttons, peas, etc., into their ears, and find them difficult to remove. The nurse should on no account try to remove these by pushing instruments down the ear, as the foreign body will only be sent further in. To remove them the child should be placed with the ear downwards over a basin and the ear syringed as already directed, when the object will almost always come away. If this does not occur the child should be taken to the doctor at once.

Wax may be removed after a few drops of olive oil have been inserted, or a few drops of hydrogen peroxide have been dropped in and allowed to soak for a few minutes before syringing.

Administration of Medicine

A part of a nurse's duty consists in the administration of medicines and applications ordered by the doctor. It is, therefore, indispensable to her to be able to avoid mistakes. She must know and acquire the habits of taking the precaution which experience has found to be necessary if these

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mistakes are to be avoided. Mistakes do occur at times, and may be of the most serious nature. They are always due either to carelessness or to bad training. The chief points are as follows—

1. All medicines should be kept under lock and key.
2. All external applications and poisonous remedies should be kept apart, either in another cupboard or in a separate compartment, and should not be kept among the medicines which are given by the mouth.
3. The nurse should always read the name on the bottle and the directions, so as to avoid giving the wrong medicine and the wrong dose.
4. In dealing with poisons she should be doubly careful. Poisons are usually contained in dark glass bottles, which are different in shape from the ordinary bottles.
5. The medicine should always be measured into a medicine glass. The markings on the bottle may be in ounces or half-ounces, and some difficulty may occur in distinguishing between the two.
6. In pouring out medicines it is always best to give a preliminary shake, especially is this necessary if there is any deposit at the bottom. Always pour out away from the label, so that the directions are not obscured by drops running down that side of the bottle. The exact amount is measured, and the cork replaced in the bottle at once. If the medicine is to be mixed with water, the

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medicine glass should be emptied into a tumbler or wine glass and refilled with water, and again emptied into the glass, so as to insure that the patient gets the full dose. In any case receptacles used in the giving of medicines should always be rinsed out directly afterwards.

7. Medicine should be given punctually at the time ordered. The following is a list of the measures, signs and abbreviations commonly used—

Weights (Avoirdupois Weight).

		Symbol
1 grain		gr.
437·5 ,,	= 1 ounce	℥
16 ounces	= 1 pound	℔.

Measures of Capacity.

		Symbol
1 minim		♏
60 minims	= 1 fluid drachm	ℨ
8 fluid drachms (480 min.)	= 1 fluid ounce	℥
20 fluid ounces . . .	= 1 pint	O
8 pints	= 1 gallon	C

Occasionally ℨ and ℥ are written f ℨ and f ℥ when they stand for fluid drachms and fluid ounces.

Domestic Measures.

A Teaspoonful is about a fluid drachm. Usually it is a little more.

A Dessertspoonful is about two fluid drachms.

A Tablespoonful is about half a fluid ounce.

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A Wineglassful is about one and a half to two fluid ounces.

A Teacupful is about five fluid ounces.

A Breakfastcupful is about eight fluid ounces.

A Tumblerful is about eleven fluid ounces.

A Drop is often taken as being about a minim, but drops vary so much in size that they should never be used for children, nor as a measure of powerful drugs. For example, the number of drops in a fluid drachm of the United States syrup of acacia is 44, of water 60, of alcohol 146, of chloroform 250.

Abbreviations and Directions.

āā (ana), of each.
Ad lib. (ad libitum), as much as you like.
B. in d. (bis in die), twice a day.
Emp. (emplastrum), a plaster.
Gut. (gutta), a drop.
P. r. n. (pro re nata), for an emergency.
Quart. hor. (quartis horis), every four hours.
Sex. hor. (sextis horis), every six hours.
Stat. (statim), at once.
T. d. (ter in die), three times a day.

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CHAPTER XXVI

MISCELLANEOUS FIRST AID

Conveyance of injured people is best carried out in specially constructed ambulances, but these can only be obtained in the larger towns. In the country simpler methods are used. Where the patient can sit up or be placed in the semi-recumbent position, a well-sprung motor-car is the most rapid and easy method to use. These are, however, advantages of peace and civilisation. In warfare or when injuries are received in more distant parts of the country, human ingenuity must be relied upon to convey the patient to medical aid with as little pain and injury as possible. It is necessary, therefore to devote some space to the chief points to be noted in conveying the injured or wounded from place to place.

Position and Circumstances.—If the injured man is far from help with only a single companion the question must be decided as to whether an attempt should be made to convey him to help, or whether he should be left as comfortable as circumstances will allow while the companion goes to obtain help. In the majority of cases the latter is probably the best method to adopt. In certain circumstances it may be necessary to remove the injured person at all events a little way, as in the

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A Wineglassful is about one and a half to two fluid ounces.

A Teacupful is about five fluid ounces.

A Breakfastcupful is about eight fluid ounces.

A Tumblerful is about eleven fluid ounces.

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Position and Circumstances. When a man is far from help and [illegible] the question must be considered whether any attempt should be made to move him, or whether he should be left where he is. The circumstances will [illegible]

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event of fire or in savage warfare, when haste is necessary.

(A) *Moving the Injured, Single-handed.*

1. *Pick-a-back.*—If conscious and able to hold on, a man can be carried pick-a-back by short stages. An improvised seat may be made with a short, stout stick or piece of wood and two handkerchiefs. The handkerchiefs are knotted into two loops for the arms of the carrier and the stick placed through the loops. The injured person sits on the stick.

2. *The Back Lift.*—If able to stand, place the

FIG. 93.—Back lift.

patient with his back to yours, slightly stoop, place your hands over your shoulders and grasp the

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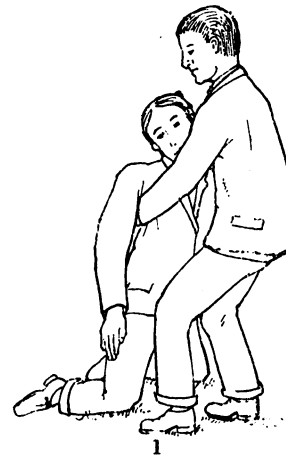
patient under the arm-pits, bring his weight well up into the small of the back, and stand up. To lower the patient to the ground, sink down on left knee, place him in a sitting posture, and turn towards the patient.

3. *The Fireman's Lift.*—If a patient is helpless he may be carried by means of "the fireman's lift." This method is well adapted for cases of insensibility, and is carried out as follows—



(i) Roll the patient over on the face, the arms to the side.

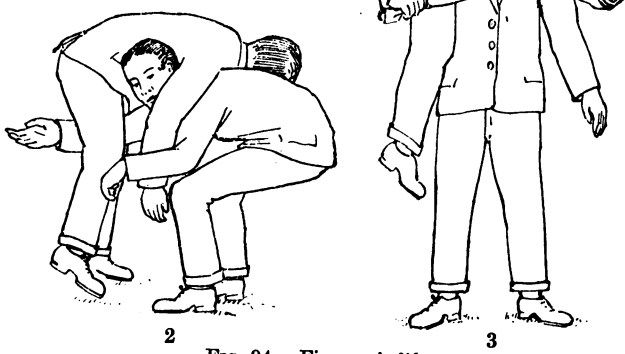


FIG. 94.—Fireman's lift.

(ii) Stand at the head, place your hands beneath the patient's shoulders, and raise him to the kneeling position.

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(iii) Place your hands under his arm-pits, raise him up, stoop, place your head beneath his body, bring his right arm around your neck, put your right hand around his right thigh, bring his weight well on to the centre of your back, grasp his right wrist with your right hand and raise to the erect position.

4. *By Puttees or Puggarees.*—Wounded men may be carried off the field by means of puttees or puggarees—

(i) *By Means of One Puttee.*—A puttee is unrolled and placed well forward under the buttocks

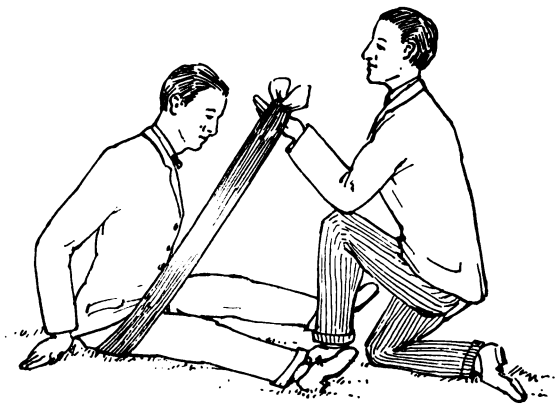

FIG. 95A.—Lifting by puttee.

of the wounded man, and tied by a reef-knot into a loop eighty-four to eighty-eight inches in length. The rescuer then bends down, facing away from the injured man, and applies the loop of puttee over his

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own forehead, and, rising, carries off the wounded man. The webbed stretcher-sling or two belts fastened end to end or

Fig. 95B.—Lifting by puttee.

puggarees from the helmet can be similarly used.

(ii) *By Means of Two Puttees.*—One puttee is placed under the buttocks of the wounded man and over the forehead of the rescuer as before. The second puttee is passed outside the first, round the middle of the back and under the arm-pits of the wounded

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man, under the arm-pits and over the front of the chest of the rescuer, and tied off at one side by a reef-knot, thus forming a loop seventy-two inches in length.

FIG. 96.—Lifting by means of two puttees.

By these means wounded men can be carried for considerable distances (one or two miles). They are especially useful for broken country and in hill warfare, but equally so on level ground; the hands of the rescuer being free, he can steady and help himself along with a stick or rifle.

(B) *Moving the Injured by more than One Bearer.*

1. *With Two Bearers.*—If the man is insensible, one bearer, kneeling behind him, passes his hands under his arm-pits and clasps them in front of his chest, the second bearer carries him feet first with a leg on either side. If the lower limb is injured,

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both legs should be tied together and carried in a horizontal position.

2. *Handed Seats.*—If there are two people available the patient may be carried by handed seats, or by an improvised stretcher. The former if the distance is short, the latter if the distance is long, a stretcher being improvised out of their coats.

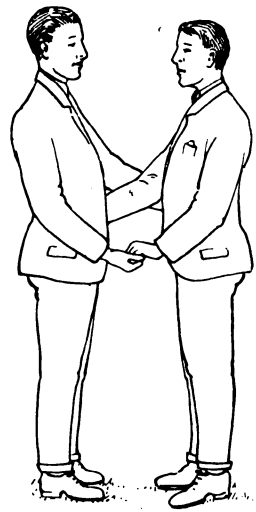

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Fig. 97.—Handed seat.

To form a hand seat, the bearers stand facing each other, the right-hand man bends his fingers at the second joint, the palm of the hand being uppermost. The left-hand man bends his fingers of the left hand in the same way, back uppermost. The two then hook their fingers together, each placing the disengaged hand on the other's hip and grasping his coat at this level. The patient then sits in the

2

Fig. 98.—Handed seat: position of hand.

chair thus formed and can be carried by easy stages, the bearers changing sides at each halt. If the patient cannot stand the bearers must kneel down

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and hook their fingers beneath his thighs, and lift him, grasping his back as they do so till they have got him comfortably up.

Carrying by Stretcher.

The army pattern of stretcher consists of two poles 7 ft. 9 in. long. Stout tanned canvas is nailed

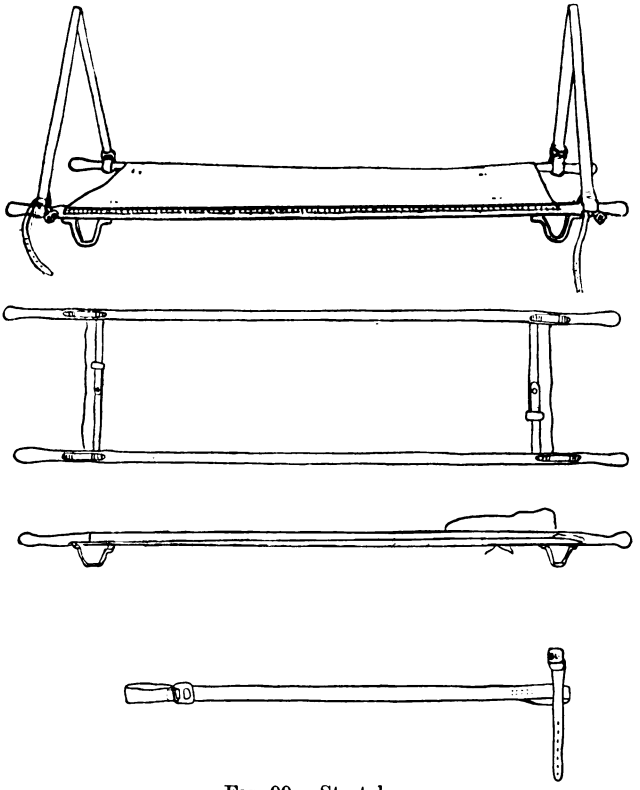

Fig. 99.—Stretchers.

to the outer sides of the poles, the canvas being 6 ft. long and the stretcher when opened being

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1 ft. 11 in. in width. It stands on runners which make it 6 in. high. The poles are kept apart by hinged transverse bars called traverses. Its weight is 30 lb., lighter patterns are sometimes used in civil life. Two slings of coarse webbing are supplied which are buckled round the stretcher and keep it shut when closed. When open and in use the ends of the poles are slipped into loops at the end of the slings, which are placed over the shoulders of the bearers.

The Improvisation of Stretchers, etc.—The improvisation of stretchers is not difficult, bearing in mind the principle of their construction, viz. some secure material upon which a patient can lie and be carried by men. Before any improvised apparatus is used for the conveyance of a wounded man, it must be practically tested by one of the party, in order to avoid the possibility of further injury to the patient from defective materials or construction. The materials necessary are generally to be found in the neighbourhood of operations, *i. e.* doors, gates, hurdles, shutters, shafts, saplings, broom-handles, corn-sacks, tarpaulins, old tents, stout pieces of cloth, great-coats, hay, straw, ferns, leaves, etc., etc., all of which have their use.

A *gate* or a *door* taken off its hinges, or a hurdle, are ready means of carriage, if at hand.

The *hammock* is the simplest special contrivance for carrying a sick or wounded man, and a blanket slung between two men, or tied to a pole carried on their shoulders offers, perhaps, the most primitive form of hammock.

By means of blankets, canvas, sacks or coats an improvised stretcher can be formed with a couple

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of poles. A horse-blanket with two or three lances passed through several slits on each side would serve to carry a man for a short distance.

A loop may be sewn at each corner of a blanket, which is then doubled over so that the two loops at each end are brought together. A pole is then passed through the four loops on one side, and another passed within the doubling of the blanket on the other side. This forms a secure and comfortable stretcher for a short distance.

Again, a good temporary litter can be made by laying two stout poles on the edges of a blanket, rolling the edges inwards, and finally making them fast by strong twine passed through holes cut in the blanket at intervals of about a foot along the poles and tied off strongly on the outside.

A length of blanket sewn on to bamboo poles makes a light serviceable stretcher; but, like the preceding forms, it has no traverses, and a stretcher not so provided is unsuitable for carrying a case which might be subjected to injurious pressure when the stretcher is raised.

Two poles, each of, say, 8 ft. in length, may be used with two cross-bars 2½ ft. each, nailed or securely lashed on to each end of them, the blanket being firmly knotted to the pole. A third cross-bar placed across the centre would keep the patient from falling out. An effective cover of bent boughs supporting another blanket could be arranged over the stretcher as a protection from sun and rain.

An emergency stretcher which takes little time to make can be constructed with a triangular frame lashed together with yarn. (A quadrangular

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frame so constructed is less rigid, and more liable to collapse.)

The requisites are: Two hop-poles or stack-props 2½ to 2 inches in diameter, not less than 9 feet long; two lighter sticks 1 inch at least in diameter, and 36 inches long; two corn-sacks, 40 inches by 24 inches (ordinary size); five yards of rope-yarn (tarred for choice). The tools required are a jack-knife, and a packing-needle extemporised out of a piece of stick. In the case of a fractured leg or thigh it may be necessary to add transverse battens to prevent the canvas from sagging and the limb from bending over the poles (the patient's heels lie outside the poles).

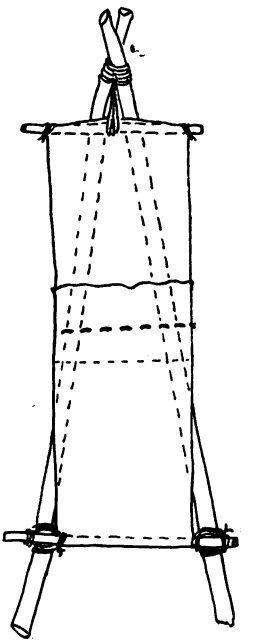

FIG. 100.—Hop-pole stretcher.

The two long poles are laid together, and their smaller ends are lashed with a lashing 1½ in. wide. The larger ends are separated until, at a distance of 7 ft. from the small ends, there is an interval of 28 in. between them. One of the shorter sticks is now passed through the bottom of a sack, coming out at each corner, laid over the poles, and lashed to each with square lashings at a distance of 7 ft. from the end lashing.

The second stick is similarly passed through the bottom of the second sack, coming out at each corner, and the mouth of one sack is passed into

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that of the other until the length of the canvas so formed is 6 ft.

The sacks are now stitched together in this position by means of the extemporised packing-

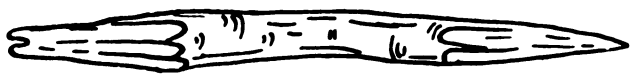

FIG. 101.—Improvised packing-needle.

needle, the sharp end being used to separate the threads of the canvas, and the cleft end to push the twine through.

The centre of the bottom of the sack nearest the foot of the stretcher is now perforated, and six

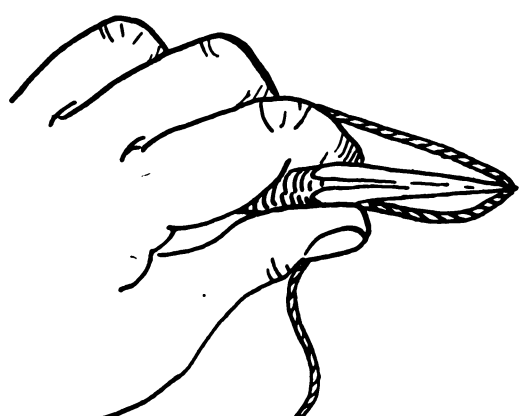

FIG. 102.—Method of use of improvised packing-needle.

turns of yarns passed through the perforation, round the stick, and round the lashing at the end of the two poles, and pulled hard until the canvas is thoroughly stretched, when it is made fast.

Such a stretcher is intended only for hand-carriage and cannot be used as a bed.

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The Coat Stretcher.—A simple stretcher can be improvised out of two strong poles and two coats supplied by the bearers. Soldiers' tunics are admirably suited for this. The sleeves of the coats are turned inside-out and the coats buttoned up. The coats are laid on the ground, buttons uppermost, the bottoms of the coats just touching one another. The poles are thrust through the coat sleeves, which are now buttoned up inside the coats. If two notched pieces of wood can be procured to keep the handles apart the bearers will be saved a great deal of discomfort.

Loading and Unloading Stretchers.—When a stretcher squad goes out to bring in a wounded person, the stretcher is carried folded. If there are four bearers in the squad they are numbered as in the drawing. No. 4 takes the command and gives the orders, he also carries a surgical haversack and water bottle for the use of the injured. When approaching the patient they will act as follows. No. 4 goes forward to examine the injury, No. 2 goes to assist him. While the patient is being dressed Nos. 1 and 3 open and prepare the stretcher in line with the patient's head and then come forward to render any assistance needed. *In loading* the stretcher, Nos. 1, 2, 3, are on the left of the patient: 1 at the knees, 2 at the hips, 3 at the shoulders. No. 4 is on the right of the patient, paying special

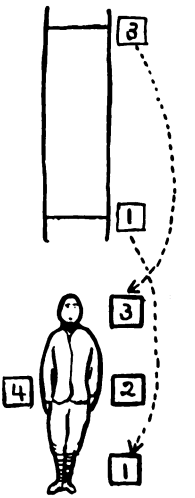

FIG. 103A.—Loading stretchers.

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attention to the injured part. They all kneel down on the left knee and pass their hands under the patient. When all are ready, No. 4 gives the word and the patient is lifted and placed upon the knees of Nos. 1, 2 and 3, the patient assisting

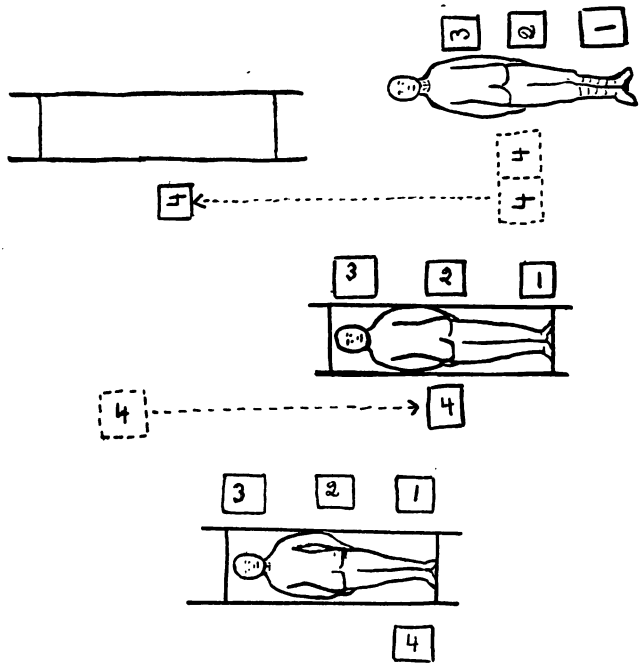

FIG. 103B.—Loading stretchers.

if he is able by putting his arms round the shoulders of No. 3. No. 4 runs back and, lifting the stretcher by placing his left hand on the far pole and the right hand on the near, brings the stretcher and places it on the ground beneath the patient, and then goes down on his knee and helps hold. When

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ready, No. 4 gives the word to lower, and the patient is placed gently on the middle of the stretcher; Nos. 1 and 3 will then put the slings over their shoulders, lean down and place the handles through the loops of the slings, and rise together, keeping the two ends of the stretcher level. The accoutrements should be collected by No. 2, care being taken to see that any firearms are unloaded at once, the muzzle of the gun or rifle being held up in the air while this is being done.

When unloading, the bearers will place themselves

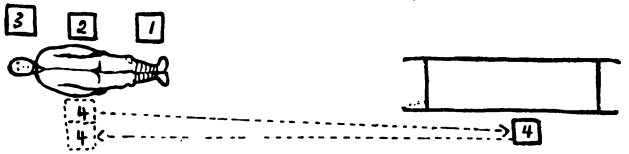

FIG. 104A.—Unloading stretcher.

as for loading, and they will kneel on the left knee and lift the patient in exactly the same way and place him on the knees of Nos. 1, 2 and 3. No. 4

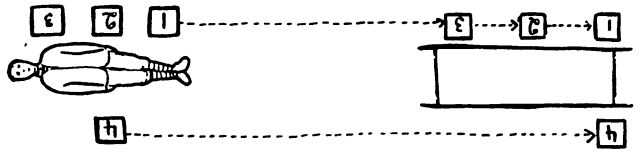

FIG. 104B.—Unloading stretcher.

giving the word to lift. No. 4 will then rise up, and, lifting the stretcher, carry it forward clear of the patient's feet and then rejoin the others. When all are ready he gives the word to lower, and the patient is placed gently on the ground.

With Three Bearers.—In the event of there being only three bearers available, the stretcher will be

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placed at the patient's head, in the same line as his body. The bearers will then lift the patient, rise to the erect position, carry him head foremost over the foot of the stretcher, the horizontal position of his body being maintained throughout the movement, and lay him in a suitable position on the canvas. When unloading, the patient will be lifted and carried head foremost over the head of the stretcher. To lift the patient, one bearer places himself on the injured side in a line with the patient's knees, raises and supports the lower limbs, while the other two, kneeling on opposite sides of the patient, near his hips, facing each other, each pass an arm under his back and thighs, lock their fingers so as to secure a firm grip and support the trunk. All rise together.

General Rules for the Carriage of Stretchers

1. *Consideration of the Nature of the Injury.*—Special care should always be taken to notice the part injured and the nature of the injury, as these determine in a great measure the position in which the patient should be placed during transport. In all cases the head must be kept low, and on no account pressed forward on to the chest.

In *Injuries of the Head*, care must be taken that the patient is so placed that the injured part does not press against the conveyance.

Fractures of the Limbs.—In wounds of the lower limb, the patient should be laid upon his back, inclining towards the injured side; this position being less liable, in cases of fracture, to cause motion in the broken bone.

In wounds of the upper limb, if the patient

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requires to be placed in a lying-down position, he should be laid on his back or on the uninjured side, as in cases of fracture there is less liability in these positions of the broken bones being displaced.

In *Injuries of the Chest* there is often a difficulty in breathing; the patient should be placed with the chest well raised, his body at the same time being inclined towards the injured side.

In transverse or punctured *Wounds of the Abdomen*, the patient should be laid on his back, with his legs drawn up, so as to bring the thighs as close to the belly as possible, a pack or other article being placed under his hams to keep his knees bent. If the wound is vertical the legs should be extended.

2. *Adjustment of Slings.*—Care should be taken at starting to adjust the slings so that the parts supporting the poles are at equal distances from the surface of the ground.

3. *Carriage of Patient.*—The patient is usually carried feet first, but in going uphill the position is reversed, and the patient is carried head first. To do this the bearers will lower the stretcher and turn about. If the patient is suffering from a recent fracture of the lower extremity he will be carried with his head downhill. The stronger and taller bearers should be downhill.

4. *The Stretcher is Carried by Two Bearers*, but a squad of four are better, as changes can be made so as to rest the bearers. The disengaged bearers walk on opposite sides of

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the stretcher and assist in taking the weight over uneven ground. When obstacles come into view one of the disengaged bearers will go on ahead to find out the easiest way of passing it.

5. *Passing a Wall or Fence.*—No attempt will be made to carry a patient over a high fence or wall if it can possibly be avoided, as such is always a dangerous proceeding. A portion of the wall should be thrown down, or a breach in the fence made, so that the patient may be carried through on the stretcher; or, if this be not practicable, the patient should be carried to a place where a gate or opening already exists, even although the distance to be traversed may be increased by doing so. It is better to do this than risk the safety of the patient.

6. *Crossing a Ditch.*—On arrival at a ditch to be crossed, one of the bearers will have found a suitable spot, and the stretcher will be lowered near the edge. Two bearers will be on each side of the stretcher and will carry the stretcher to the very edge. The two front bearers then descend into the ditch, lay hold of the handles of the stretcher, and, lifting it, draw it forward; the remaining bearers in succession descend and take hold of the stretcher, which is then carried forward to the opposite side, and the front pair of runners rested on top of the bank.

The two front bearers now climb up and guide the stretcher, which is pushed forward by the other bearers until both pairs of runners

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rest on the ground. The remaining bearers climb out and the whole, lifting the stretcher carry it forward clear of the ditch and place it on the ground. The bearers then take up positions to carry it as before.

Moving the Injured by Horseback.—The removal of a wounded comrade by mounted men is a useful practice in all mounted corps..

A man can be brought out of action on a horse without any special contrivance for carrying him other than the saddle. If only slightly wounded, he may be able to ride off unaided, or he may be assisted out of action by a comrade sitting behind him, or by one walking on either side of his horse. If dismounted, he may be given a stirrup and assisted to mount behind the rider, or, if unable to mount in this way and another horse is at hand, the comrade may dismount and help him up. If badly hit the comrade should place the wounded man in front of him facing the horse's tail, and hold him in his arms; the wounded man, if able to assist, holding on to the cantle of the saddle with both hands; or he may be laid across the saddle face downwards, supporting himself with one foot in a lengthened stirrup, while the horse is led by a comrade.

To carry an insensible man on a horse, make, if possible, a pad with a horse-blanket or sack on the saddle, place the man astride over the horse's withers, his body lying on the saddle face downwards, his head towards the horse's tail; cross the stirrup-leathers over the man's back, and secure the stirrup-irons by the head-rope from the off to the near-side under the horse's belly. The man's legs hang clear

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of the horse's shoulders, and the animal may be led out of action, or, in savage warfare, galloped away.

To Remove a Wounded Man from a Horse.—Three bearers are enough, but a fourth can hold the horse's head. First of all the man's spurs must invariably be taken off whatever the injury may be, and if the horse is restive a foreleg should be held up with the knee bent. In the case of an injured lower limb, Nos. 1, 2 and 3 approach on the wounded side. On the word given by No. 1, " Lay-hold," No. 1 from behind takes hold of the pelvis and sound leg, No. 2 is held round the neck and shoulders by the wounded man, and No. 3 holds the wounded limb. On the words " Ready, lift off," the patient is taken off and held over the stretcher placed alongside, and on the word " Lower " is laid on it. In the case of an injured upper limb the wounded man is approached on the sound side. No. 1 supports the pelvis and leg, No. 2 is held round the neck by the patient's sound arm, and No. 3 supports the wounded limb. Words, same as before.

Moving the Injured by Ordinary Vehicles, Carts, etc.—There is no need to give an account of ambulance wagons as they are familiar to those engaged in Red Cross work, and are always accompanied by orderlies who are thoroughly acquainted with their use and possibilities. It may, however, be necessary to convey injured or sick by means of ordinary vehicles, and a knowledge of the most important points will be found useful.

Preparation and Loading of Wagons and Country Carts.—If the vehicle has been commandeered and is to be driven by any one other than its owner, a careful examination must be made to

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see that the brakes are working, the axles and shafts are sound, and that the linchpins are in place. This should be done before the patients are loaded in.

If the patients are to be moved some distance the carts should have some form of covers fitted as a protection from sun and weather.

Patients may be carried on stretchers in the vehicles or lying on some springy material on the floor. In the latter case a plentiful supply of straw, hay, dried leaves or bracken may be strewn on the floor and sides, about 15 lb. of the material for each lying-down patient, some of the material being tied up in bundles as pillows. If mattresses and bedding are available, they should be laid on top of the straw.

In Loading General Service Wagons (ordinary four-wheeled wagons) so prepared, the stretcher squad will act as follows. On the command "Load wagons" being given by No. 4, all four bearers turn towards the stretcher, stoop, grasp the poles of the stretcher, hands wide apart, palms uppermost. Then working together they rise slowly, lifting the stretcher, holding it level at the full extent of the arms. On the word "Advance" being given, they step off with a side step, crossing their feet in front of them, the first step being taken with the foot nearest the wagon. They halt one pace from the tail of the wagon and raise the stretcher to the required level and place the front runners on the floor of the wagon. The two front bearers will get into the wagon and, with the assistance of the others, lift the stretcher into position, unload it and remove it. The patient should be placed in the most comfortable position, special care being taken to support

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the injured part and prevent its movement during transit. No. 4 gives the necessary instructions for the careful handling of the patient and removal of the stretcher. This method, suitable for seriously injured cases, requires that there should be sufficient space in the vehicle for its accomplishment. After one or more patients, according to the size of the vehicle, have been placed on the mattresses, etc., others, less seriously injured, may be carried or assisted in without the use of stretchers.

Sometimes lying-down cases have to be put into the wagons without the aid of stretchers. When this happens the bearers, following as far as possible the instructions given for lifting wounded (see p. 409), will lift each wounded man and carefully carry him to the wagon. On arriving at the back of the wagon No. 4, or a bearer directed by him, will get in, and, supporting the patient under both shoulders, will lift him in, being assisted by the other bearers, who will subsequently get into the wagon and help to place the man in the most comfortable position. In unloading, this proceeding is reversed.

Occasionally it may be necessary to dispatch a patient on a stretcher, in which case the stretcher will be carefully lifted into the wagon, as described before, and secured by means of straps or rope-lashing.

Various means have been improvised for this purpose with the object of minimising the jolting of springless vehicles. The principle usually adopted is that of fixing poles or branches across the wagon secured to the sides, and slinging the stretchers from the poles by means of ropes. Material for the purpose can generally be found in farms and villages, and with a little ingenuity and skill in carpentering

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satisfactory fixtures can be constructed. A suitable method of adaption, as applied to a Scotch haycart, with a view to forming extemporised springs, is illustrated in this figure. The value of it is that it

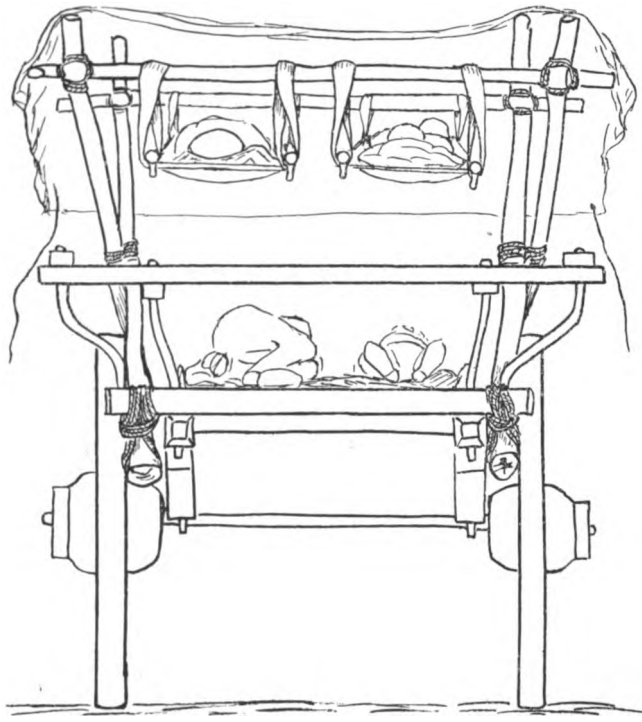

FIG. 105A.—Cart adapted to ambulance.

can be applied to almost any large vehicle, and the requisites for its use can be found in most farmyards.

The suspensory apparatus consists of four poles, in two pairs, which are crossed about their centres, and rest upon a transom across the top of the cart's body, which takes the downward thrust. The

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lower ends must pass under, and are lashed to the projecting ends of the lower transoms at the ends of the cart, which take the upward thrust. Lighter transverse poles are lashed to the upper surfaces of the crossed poles, the distance between them in plan being 6 feet. Looped stretcher slings and rope are placed round the transverse poles (four on each), the stretchers are suspended from them. In this

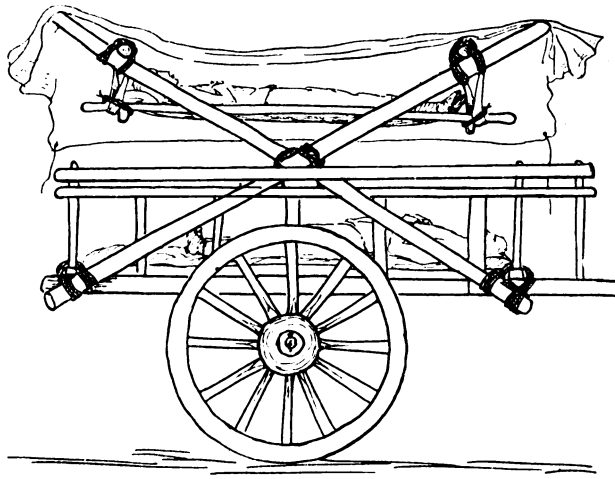

FIG. 105B.—Cart adapted to ambulance.

case, for each stretcher, two loops are formed from stretcher slings and two from ropes. Square lashings are used. The loops are secured from slipping by lashings passed above the handles, and below and behind the runners of the stretchers.

For the suspensory apparatus are required two stretchers with slings, 20 yards of ¾-inch cord (often to be found in stackyards), four stack-props, which are larch poles 10 feet 6 inches by 3½ inches tapering

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to 2½ inches, and two lighter poles of 2½ inches in diameter and not less than 5 feet 6 inches in length, which should be cut to length after lashing.

For the floor of the cart are needed four sacks of about 3 feet 6 inches by 2 feet, and 48 pounds of straw. To cover the wounded, a tarpaulin of about 8 feet by 12 feet is required.

The tools required are a yard-measure, a saw or billhook, and a jack-knife.

The amount of spring given by the crossed poles, transverse poles and stretcher handles combined is sufficient to absorb any ordinary shock. The floor can be used for two slightly wounded patients. One of these carts would thus carry four wounded men lying down.

The method of loading is as follows : The wounded on stretchers are first loaded; four bearers are necessary. The shafts should be propped, and the suspension-loops should be adjusted so that the stretcher is horizontal. The stretcher has to be raised to a considerable height (the top of the body of the cart), where it is rested, and subsequently lifted until the handles can be put into the loops.

No. 1 bearer gets into the cart, while the remainder raise the stretcher and place its handles upon the upper back transom of the body of the cart.

No. 1 takes the handles, and, assisted by the remainder, eases the stretcher forward until its front handles can be supported by the upper forward transom.

No. 3 now gets into the cart, No. 4 keeping the rear end of the stretcher raised, and Nos. 1 and 3 raise the stretcher to a level with the loops. No. 2 now gets up and places the loops over the handles.

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Electric Shock.—Electric shocks are now common occurrences, owing to the use of electricity in many commercial enterprises. The greatest care should always be exercised never to touch the naked cables by which trams, trains, etc., are driven. This is a caution which is often forgotten if through an accident the standard supporting the cable is thrown down and the cable lies in the street. Neglect of ordinary precautions will not only endanger the life of the careless, but may also sacrifice those of the rescue party.

Electricity kills in two ways. First by the passage of the current through the heart, upsetting its beats and perhaps paralysing it at once. Secondly by its action in stopping respiration. Electricity also causes the muscles to contract, so that a person in contact with the cable may go into violent spasms.

The Path of Electricity through the Body.—Every one should know something of this so as to be able to act in a safe manner in an emergency.

The skin and tissues of the body offer great resistance to the passage of the electric current through them, the current will therefore pass to earth by any other means it can. This resistance is greatly increased by dryness of the skin, and can be diminished very much by wetting. Clothes, boots, etc., also offer great resistance to the current and in this way protect the body to some extent; wet clothing again does away with this resistance.

If the current does pass through the body, it passes directly by the shortest possible route, and only a small amount will pass in elsewhere through the body.

If one foot treads upon the cable and the other

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foot is on the ground the current passes up one leg and down the other, and very little finds its way up to the region of the heart, and the current though strong would do very little real damage. If, on the other hand, the current passed from one hand to the other across the body the heart would receive the full force of the shock and might be paralysed instantaneously.

If, therefore, a person has to be rescued quickly, the hands should not be used, it is much safer to push or kick him away with the feet. If this cannot be done a roll of cloth or puttee, or an indiarubber hosepipe, should be used to throw over him to drag him off, or a broom handle used. If the hands must be used the clothing should be laid hold of and not the hands or bare skin of the victim. Nothing wet and nothing metal is safe. Good insulators are all forms of rubber; mats or motor tyres may be stood on and the patient lifted with safety, or rubber gloves or a tobacco pouch used to protect the hand. Plate glass, if stood on, is an efficient insulator. As soon as the patient is liberated from the actual contact, artificial respiration should be started at once, stimulants may be given and treatment carried out to counteract shock.

Restoration of the Apparently Drowned.—As soon as a person has been recovered from the water and drawn into a boat or on to land, and it is found that respiration has ceased, breathing must be started again without loss of time. Schäfer's method is the best as it is easiest to carry out, and can be maintained indefinitely by one person. The patient should be placed face downwards on the ground with the arms forward and the head on one

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side. If possible a bundle made of clothing, sails or any gear near at hand can be placed under the abdomen, so that the water will run naturally out

FIG. 106A.—Schäfer's method of restoring apparently drowned.

of the mouth. No time, however, is to be lost searching for material as every moment is of value; don't waste time with the man's clothes. Place

FIG. 106B.—Schäfer's method of restoring apparently drowned.

yourself kneeling astride the patient's thighs, place your hands flat on the small of his back, with the thumbs parallel and nearly touching, and the

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fingers spread out over the lower ribs, lean forward with the arms straight and allow the weight of your body to fall on the wrists to produce a steady downward pressure on the loins and lower part of the back. This part of the operation should occupy the time necessary to count one, two, three slowly. This will press the air, water and slime out of the lungs and wind passages. Then release the pressure by springing backwards, so as to free the chest and allow air to enter. Do not lift the hands from the back. This part should occupy the time necessary to count one, two, slowly.

Repeat this forward and backward movement, making pressure and relaxing it, about twelve to fifteen times a minute. In other words, sway your body forwards and backwards, upon your hands once in every four or five seconds. No violence is needed. While the operator is thus engaged, others may help in different ways. One may run for a medical man if one is near by, another runs to the nearest house and warns them to prepare a bed for the patient later. The sheets should be removed and the blankets warmed and hot bottles prepared. The same individual should return at once to the patient with a dry rug or blanket to wrap the patient in, some brandy and possibly a hot bottle. Others may undo the wet clothing, which is removed without interfering with the artificial respiration. Friction should be applied to the limbs, all the rubbing being from the extremities towards the trunk. Limbs which are not being rubbed should be wrapped in dry towels or coats of the bystanders. When respiration has been restored the patient should be left a little while and watched carefully,

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as the breathing may stop later. If all is well he may be rolled over on his side and friction made on the trunk. A little stimulant may be given by the mouth as soon as he can swallow. He should be wrapped in the dry things if these have arrived, and left lying a little while longer. If there are no dry things available he should be carried at once to the nearest house and put to bed, and warmth applied till the circulation is restored. He may vomit up some of the water he has swallowed if that has not already been squeezed out of him. When in bed he should be given some hot beef-tea, coffee, tea or whisky, and then encouraged to sleep. There is no necessity to place him in a hot bath. It is often difficult to keep curious people from crowding round and hampering the workers, and it is as well to tell off one or two of the most officious to keep the others back: so long as they have some official position they will be quite happy and will probably do it well.

Artificial respiration is needed also for those overcome by breathing noxious gases, such as charcoal, fire-damp or water gas, which is gas given off when water is poured on to burning houses, firemen are frequently overcome. It is also needed in cases of hanging, lightning stroke, severe electric shocks and chloroform poisoning.

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